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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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New England Water Works Association

LOCAL only in name, the New England Water Works Association meets every second or third years outside New England. Next week it goes to Albany, which because of its convenient location and other attractions should bring a large attendance. In honor of this convention a large part of this issue of *Engineering News-Record* is filled with material of strong appeal to waterworks men. These articles range over a wide technical field and a broad geographical area, the latter including a pipe line constructed in Chile under adverse conditions.

Court of Last Resort

INTERESTING in the extreme are the developments in the industrial situation during the past week. The Boston policemen's strike, the refusal of the unions in the steel trade to postpone their proposed strike at the President's request, the unreasonable demands being made by the printers in New York, and other incidents, indicate clearly that radicalism is pressing for a test. As a result, the conviction has become general that the situation has reached the pass where temporizing is futile—that employers must refuse to go beyond reasonable concessions and bear the burden of strikes. Concessions to unreasonableness only prepare the way for future and more unreasonable demands. Until recently the plea was for wage increases to meet the cost of living. That is now thrown aside and the demands are made merely because of belief in the power to enforce them. Strikes must be allowed to come, and that will carry the case to the court of last resort, the public. Does it stand for radicalism or sanity? We do not doubt the answer. The public's attitude at Boston was a certain indication of what it will be.

The Hopeful Features

IN THE ranks of labor itself the contest between the radicals and the sane men never showed itself more plainly. In debating the proposed steel strike the presidents of the international unions wished to abide by President Wilson's request; the organizing committee stood for quick action. In New York the printers' unions loyal to the American Federation of Labor have come out openly against those whose charters have been forfeited and who are making unreasonable demands, while anyone who comes in contact with the workers knows how widespread has grown the feeling in union ranks against the radicals. Even those who acquiesced before see now that the hot-heads are carrying our industries pell-mell to destruction. Reaction is always certain to come against extreme measures. It has set in in full force in labor's ranks. That fact and the certainty of sanity on the part of the public are the hopeful elements of the situation.

Values Versus Capitalization

MR. PLUMB, in advocating employee operation of the railways, has declared that the Government's valuations were disclosing large overcapitalization. He believes that some $6,000,000,000 could be squeezed out of the eighteen billions of the railroad capitalization—or, in other words, that the Government should properly pay only $12,000,000,000 if it should decide to acquire the roads. It is interesting, therefore, to learn that the Interstate Commerce Commission is reported to have placed its tentative valuation of the Chicago, Rock Island & Pacific Ry. at $410,000,000, which is $64,000,000 in excess of the par value of its outstanding bonds and stock. The valuation is made as of June 30, 1915, since which there have been additional conceded capital expenditures. In the case of the Central of Georgia Ry., which has $57,000,000 of bonds and stocks outstanding, the Government's tentative valuation is $88,000,000 for reproduction new and $72,000,000 for reproduction less depreciation. Of the other tentative valuations completed by the Bureau of Valuation, three out of four do show reproduction cost less than the capitalization, but the total mileage of roads on which tentative figures have been set is only 1840 miles. In the valuation of the railroads of New Jersey in 1911 the value new was reported to be $351,000,000, the present value $343,000,000 and the capitalization $357,000,000. In these figures one fails to find justification of Mr. Plumb's prediction.

The Bankruptcy of Socialism

FROM various sources we are learning of the change in point of view of the Russian Bolshevist leaders. Pure democracy having broken down, they are rapidly putting into effect the despised methods of the system that they destroyed. Mr. Hoover, in his thoughtful address in New York last week, told of the change. They have abandoned the socialization of land, they have reëstablished a differential wage in order to stimulate men to do their best, they are willing to pay handsomely those who can direct enterprise, they are restoring individual ownership and protecting the individual in the fruits of his labor. The same story is told in more detail in a letter from the Stockholm correspondent of the New York *Evening Post*, published Sept. 6. All these things were, of course, foretold. As Mr. Hoover points out, our industrial system is not perfect, but its main features—private ownership, freedom for initiative and remuneration proportionate to performance—are the results of a thousand years of experience and social experiment. Moreover, they rest on the unfailing human characteristic of doing well consistently only when one's own interest is at stake. The pertinent question, as Mr. Hoover points out, is whether we can learn from the bankruptcy of socialism in Russia

and Hungary or whether we will be plunged into the same abyss, and, after sorrows and disaster, painfully reconstruct that which we now have. Some changes in the machinery are needed here and there, but by and large the system is good. It is our duty to see that the hot-heads do not relegate it to the scrap heap.

The Social Theorist

MR. HOOVER'S reference to the *dilettante* leaders of Russia reminds us of an engineer with whom we recently have had contact. We cite him, not because he is an engineer, nor because as an individual he is important (for he is not), but because he is of the type of citizen who is causing much trouble. This engineer is notorious among his associates for his inability to reach a decision. His work piles up until someone goes over the heap with him and gives the final word on each item. He is seeking "a big job at big pay," though he has demonstrated his incapacity as an executive. He has never handled men, nor has he ever been responsible for a payroll. Yet he has very positive ideas on how industry should be reorganized and *socialized*. Unable to make decisions on his own little job, he does not hesitate to decide the future of all industry and to give free expression to his views. How lame many of us would appear if before we pressed our opinions on the multitude we were obliged to present evidence of competence! There would be less talk and more sound, humble thinking.

Reclassification of Federal Salaries

ENGINEERS and engineering societies should be keenly interested in the reclassification of Government salaries being made by a Congressional commission. Inadequate salaries of engineers and scientific men in Government employ have always been used as evidence by those who desire to hold down the compensation of their own engineering employees. Consequently, each member of the profession has a personal, as well as a citizen's, interest in seeing that the Government pays its technical employees adequately. For that reason we commend to the consideration of engineers the article in this issue regarding the classification of the engineering employees of the Dominion of Canada made by Arthur Young & Co., an accounting firm which was retained by the Canadian Government and is now engaged in making the reclassification for our own Congressional joint committee. The Young report has met with much protest from the engineers of the Dominion. Presuming that the firm will proceed on the same basis here, it is the duty of engineers to become interested in the question now, while the reclassification is under way, rather than to wait until a finished document, carrying much weight with members of Congress, shall have been produced. Prevention is better than cure. With the inadequacy of the Canadian report as a text, engineering societies should place before their Congressmen the view that in the present reclassification of salaries engineers should be compensated in accordance with the importance of their service and the educational and experience requirements needed for the discharge of their duties. The Congressional commission, we have no doubt, is determined to be fair. We should regret to see it misled by the advice of those who, judging by their Canadian report, have an inadequate appreciation of technical services.

A Great Ideal of Public Service Realized

THE dinner given by the engineering profession in New York City last week in honor of Herbert Hoover was, as W. L. Saunders, the toastmaster, said, an occasion without precedent in the world's history. The organization of which Mr. Hoover has been the executive head has saved from starvation since the armistice a hundred million persons. Even more it has been an important factor in starting new governments on their way. This second intervention has saved Europe as truly as did our intervention in the war.

The engineers of America may well be proud that one of their number, a graduate of an American engineering school, one who by his talents alone won international professional eminence, has rendered a service to humanity whose magnitude dwarfs anything ever before recorded. The profession may well bestow honor on Mr. Hoover, for he has attained the noble ideal, that has long animated the minds of many members of the profession, of the great service which engineers of the requisite ability might render the public. The fact that a few partisan critics have barked at his heels is all the more reason why engineers should honor him.

And the bestowal of such honors means much more than merely paying a deserved tribute to the man himself. The great end to be sought is to educate the public to the value of expert nonpartisan service when rendered with the ability and the patriotic spirit that Mr. Hoover has so marvelously displayed. The solution of many of our most pressing social problems is to be sought through the service of such men, who have the ability to organize not only things but men and who have the breadth of vision and broad sympathies that are effective to disarm opposition and end controversy.

The Plight of the Colleges

DURING the first week of October, Harvard graduates with an elaborate international organization will undertake an intensive drive for $11,000,000 or more for an unrestricted endowment fund for the university. At the same time Massachusetts Institute of Technology is instituting a $7,000,000 and Cornell a $5,000,000 campaign.

In support of the Harvard drive is a statement of the conditions that obtain in the oldest and perhaps the richest university of America. It is full of importance not only to Harvard men but to all who are interested in higher education in America. Harvard has today an endowment of upward of $33,700,000, and yet of this amount only $2,600,000 is unrestricted. With this large total in hand, Harvard has been for some time unable to make both ends meet.

The scale of salaries paid to professors and instructors has proved to be so inadequate that Harvard is no longer able to hold many men of unusual scholarship and teaching ability on its faculties. This scale of salaries, established in 1906, runs from $1000 to $1200 a year for instructors, up to $4000 to $5500 a year for full professors. The scale is probably higher than that of all but a few of the higher institutions of learning in this country, and yet it has proved inadequate, and with all her resources Harvard has been unable to grant increases.

A large portion of the new endowment will therefore be devoted to increasing the salaries of the instructional staff in all departments of the university.

Beyond this, large funds are to be established for increased activities of the various graduate schools.

If Harvard and "Tech," with their huge endowments, and their large alumni lists, find their situation serious, what must it be for the various engineering schools and smaller endowed institutions of learning throughout the country? If these great schools find it difficult to retain the services of suitable men on the faculty, what must be the struggle in institutions where the professors have the possibility of getting not $5500 but $2500 and even less as a reward for a lifetime of devoted service? In engineering schools particularly the war developed a serious situation. Men who had determined upon a career of teaching found that it was difficult to provide even the bare necessities of life on their salaries, unless they were fortunate enough to have private means or outside income. Besides this, many found for the first time opportunities to render service to large manufacturing or engineering companies where the prospects of greater comfort in life and secure old age lured them from their chosen profession. Obviously, if the standards of our colleges are to be maintained and improved additional resources are necessary. Industrially we are headed toward a loss of our position if the ranks of science and engineering are not supplied with capable men.

Not only should the drives now being undertaken have full support, but college alumni generally owe a duty to their respective institutions to assist in bringing about financial conditions that will insure the retention and building up of teaching staffs fully adequate to the demands which the country is making on our higher institutions of learning.

Gas and Aircraft Warfare

ENGINEERS have an especial interest in two phases of the proposed Army reorganization, aside from the subordination of all technical officers, discussed in these columns Aug. 21. These two phases are the inadequate provision for air service and chemical warfare. In previous wars there were, leaving out the Navy, three combat branches of the military machine—infantry, cavalry and artillery. The cavalry ceased to function in this war, but two new services, aircraft and gas warfare, with a technique setting them apart from the other combat arms, assumed major importance. In aircraft we barely had a beginning when we entered the war; in gas warfare we were totally unprepared. Despite our previous unpreparedness and the rise of these branches to first importance, the General Staff proposes to emasculate them. If their plans are adopted we shall find ourselves in another conflict no better prepared than we were at the beginning of this war.

It is alleged that gas warfare is inhuman, and for that reason is barred from future wars by the League of Nations pact. The evidence, however, does not support the contention. The proportion of fatal to total gas casualties is lower than the percentage of fatal to total bullet and artillery casualties. But, beyond that, it is certain that, despite the spirit of the League of Nations pact, other nations will continue to prepare for gas warfare. both in offense and defense. If we could be certain that gas would never again be used, we could, with clear minds, discontinue all gas-warfare study. No sane man, though, will place complete reliance on any peace pact. Laboratory experimental work, it is true, is to be permitted, but not the full-scale experiments and drill in gas attack and defense which alone are effective in military preparedness.

Regarding the air service, nothing need be said as to the need for aggressive experimentation and the maintenance of effective air forces and equipment. Today, while England is arranging to maintain an air force of some 50,000, the United States, despite its big war development, could not put a single effective squadron in the field. The machine built up under stress of war should very properly have been scaled down to a peace basis. But it should not have been reduced to impotency, demobilized to its weak pre-war position.

Both services are scientific to the last degree, and therefore of special concern to engineers. Engineering societies owe a duty to the country to protest against the inadequate provision for these arms of the service.

The Albany Waterworks: 1800-1919

GLIMPSES of the doings of the Albany Water-Works Co., a century and more ago, afforded by official minutes, show the trustees trying to solve some of the same problems that confront water-works men today. In particular, the demand for water outran the capacity of the works, "wanton waste" prevailed and rates had to be readjusted to make income equal outgo. Much the same difficulties are experienced in Albany under municipal ownership a hundred years later and to them are added the later problem of so treating a highly contaminated water as to render it safe for human consumption.

The basis of charging for water in Albany in 1802 (see page 605 of this issue) seems absurd enough now but it was no more unsound than those in force in many cities today. The amount paid for water by citizens of Albany when the works were started depended on the number of fireplaces in the house—which at best was a measure of ability to pay rather than of service received. A little later a more rational basis, the size of aperture, was adopted, but in 1815 the size and character of dwellings, and in some cases the number of front windows, governed the water-service charge.

Progress has been made in framing water-rate schedules in Albany in a hundred years, but as only 45% of the services are metered flat rates are still paid by most of the consumers. Such rates at best are arbitrary, are likely to be unfair, and encourage water waste. It is not surprising, therefore, to find the Albany water expense and income in a constant race with each other, with expense sometimes in the lead—always, perhaps, if capital charges on the entire cost of the works instead of only on the unredeemed bonds were taken into account.

A hundred years after Albany joined the small number of cities—less than a score—provided with public water-supplies it again put itself in the pioneer class. This was by adopting sedimentation and slow-sand filtration, which resulted in a heavy reduction of typhoid in Albany. Water consumption and waste at that time was about 200 gal. per capita and despite the earnest efforts of some of the city officials it has remained substantially at that figure ever since, reaching 232 gal. last year. Had consumption been reduced to the figures obtained by other cities that have metered all their consumers the original filters would have been adequate

for many years, although perhaps seriously handicapped in times of freshet and high turbidity.

Whatever might have been, the fact is that Albany has successively adopted preliminary filtration, chlorination and coagulation in conjunction with the original sedimentation and slow-sand filtration plant, as stated more fully on p. 604. At times, some of the water from the preliminary (or mechanical) filters is bypassed around the slow-sand filters lest these be overburdened. Coagulation, for reasons of economy or in deference to remnants of the old prejudice against it, is not practiced the year around. Chlorination, the great water-insurance agency, is used on all the water. The purification works as a whole interpose a barrier against typhoid from the sewage-laden Hudson, but the water supplied is sometimes high in color.

Need for rigid economy probably explains some of the steps taken at the purification plant, both as regards new construction and daily operation. If the prejudice against full metering could be overcome and the objections to coagulation be broken down or ignored, Albany might be insured an ample, safe supply of water from the Hudson River at least until conditions warranted going as far afield as may be necessary for a relatively pure all-gravity supply. Metering would not only reduce consumption and waste; it would also distribute the burden of the supply equitably among consumers and make it easier than now to readjust rates to meet expenses. The water-works officials realize all this, but the water consumers do not. The campaign of education should be continued with unceasing vigor.

Private Versus Government Ownership of Railroads

PROBABLY to most engineers the presentation by Colonel Wilgus and Mr. Lindenthal, in our issue of Sept. 11, 1919, of railroad plans predicated on Government ownership came as a great surprise. Both men are noted for the soundness of their views, both have long acted as advisers of great railroad systems. As we understand it, neither of them is personally in favor of Government ownership. They believe, however, that it is inevitable; and, so believing, they hold that it is the part of wisdom to help guide the inevitable into the best channels. Nor are they alone among eminent engineers in holding this belief; we could name half a dozen engineers, all nationally known, all with railroad-service records, who hold similar views.

Engineering News-Record believes that the railroad question would be solved best for the public by the retention of private ownership, but we appreciate the reasons that have led many to acquiesce in the acquirement of the roads by the public.

The regulatory efforts of recent years have placed the railroads—and, in fact, all public utilities—in a class apart from other industries. The independence of action usually associated with private ownership has been severely curtailed. Income is fixed by rate regulation; outgo by full-crew and safety laws and, latterly, by wage increases. From another quarter, the brotherhoods, have come further restrictions, through the weakening of the disciplinary power of earlier days. The railroads, in fact, for years before the Government assumed control, were under a quasi-public form of operation. Under that control their financial condition constantly grew worse.

Into this situation the war has injected no really new element, but certain factors previously operating to curtail the initiative, freedom and financial stability of private operation have been intensified. Quasi-public operation has given way to full Government control; labor's strength is much greater than it was. Railroad credit, weak before the war, is nonexistent today. The Government has the roads and cannot turn them back without facing widespread railroad receivership and wreckage, or giving assurance that revenues adequate for the restoration of credit will be allowed.

Under these circumstances the cry for Government purchase has naturally been strong. In fact, its strength is such that many believe it will prevail.

No one is able to say positively what the sentiment of the country is on the subject. We know where the railroad brotherhoods stand, and there is reason to believe that the entire membership of the American Federation of Labor will stand with them. At the other end of the scale, we have the recorded vote of the United States Chamber of Commerce, the business managers of the nation's industries, in favor of the continuance of private ownership. We know that the farmers are opposed to Government purchase. But where the great middle class of the cities stands, the salaried people, who in this instance probably hold the balance of power, no one can predict. We are inclined to believe that this group would at least split even, throwing the preponderance toward private ownership. Yet no one can say definitely what the result of a plebiscite would be.

The highest hurdle that private ownership finds before it is the guarantee. Many argue—and that argument has great popular weight—that rather than guarantee the securities of others the Government would better issue its own obligations; moreover, assurance of adequate rates is but an indirect guarantee. Will the public permit such a guarantee to be given? An adequate-rate guarantee would meet with the less objection.

In connection with guarantees, it must be remembered that in the end the people must pay their transportation bill—either through rates or taxation. This being so, the critical question is, Under what plan can transportation be manufactured most cheaply and satisfactorily? All available records force us to throw out the alternative of Government operation in such an inquiry; there would be left private operation under Government ownership and private operation under private ownership. With the money market as it is and under ordinary methods of financing, the one plan offers no greater economy than the other. Mr. Lindenthal proposes, though, a scheme that would reduce the cost of capital to the Government. That would tend to make the Government-ownership plan the more economical. Offsetting that, however, would be the inevitably greater interference in operation, an interference that would likely more than offset the 1 or 2% saving in the interest rate.

Whether such considerations can be effectively put before the public, though, is problematical. The mass of the people act on feeling rather than reason. The strike of the patrolmen at Boston and the threatened strike some weeks ago of the railroad shopmen have done more to bring sober thinking than could a large amount of oratory and printer's ink. Possibly such radical extravagances may help to stay the drift which Colonel Wilgus and Mr. Lindenthal feel is sweeping us to Government railroad ownership.

Constructing a 98-Kilometer Water Conduit in Chile

Wrought-Iron Pipe for Toconce Line Carted and Dollied and Supplies Moved by Carts and Pack Mules Through Mountainous Desert—Much Pipe Laid by Machine—Camp and Conduit Costs

By George H. Bayles

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Most of the ordinary problems of construction have been met and conquered by engineers of experience, and the young engineer can turn to their records for guidance; but occasionally new conditions present new problems that have to be met in new and untried ways. On the pipe-line job described in this article several unusual problems presented themselves, and an idea is given of how they were solved. The work was in a strange and unusual location and most of the men connected with it were new to the work in hand and possibly did not meet the emergencies in the best way. But it is not likely that soon again will there be such difficulty of obtaining materials and equipment as was experienced on this job; in fact, they could not have been procured at all except as a war measure, to aid in the rapid and economical production of copper. Even at that, delays were annoying and often very expensive.

It is probable that American capital will in the near future be invested more largely than ever in South American developments and that the American engineer will have many unusual situations to meet. A short description of this job, with some record of the cost and amount of work the ordinary laborer can accomplish under the conditions may therefore prove of some value. The climatic and weather conditions here described are not far different from what may be expected anywhere on the great tablelands of Bolivia and Peru and the highlands of northern Chile, which, taken together, comprise the principal South American mineral region.

DESERT and mountainous country combined in making unusually difficult the construction of a wrought-iron pipe line 6 and 9 in. in diameter and nearly 100 km., or about 60 miles, in length, for the water-supply of a copper mine and camp in Chile. Provision of water for use on construction, getting in camp and other supplies and moving pipe to place, all over poor roads and trails, were included in the difficulties. Most of the pipe was laid by machine. Careful records of cost were kept. The mine is five miles from the nearest point on the main line of the Antofagasta to Bolivia Railroad, and is in latitude 23° S., on a mountain side 12 miles from and 2000 ft. above the nearest stream, at an elevation of more than 9000 ft. above the sea and in the midst of an absolute desert.

Before the new pipe was laid, slightly brackish water, suitable for most uses in the plant operation, was obtained through a gravity pipe line from San Pedro, about 37 miles to the northeast, and fresh water for domestic boilers and other necessary uses was purchased from the A. to B. Railroad Co. and pumped five miles from San Salvador to the mine and plant. By the time the plant was in full operation, reducing 10,000 tons of ore a day, the daily cost of buying and pumping fresh water was nearly $300, corresponding to an investment of approximately $2,000,000. An investigation by the company's chief civil engineer disclosed only two possible sources of supply, and the final decision was in favor of getting the water from the Toconce Springs.

The Toconce Springs are situated 60 miles east of Chuquicamata, and are a group of several good-sized springs of fresh water running out close together from under the toe of an ancient broken lava flow (Fig. 1), which comes down from the great central ridge of the Andes ten miles east. The springs have a practically constant flow of 12 sec.-ft. They are at El. 13,435 ft., near the head of the Salado River basin, which has an elevation of 8000 ft. at the lowest point on the pipe line and is bounded on two sides by ranges of snow-capped mountains running up to 22,160 ft. (Cerros de Tocorpuri). The general direction of the valley is westward from Toconce Springs for 40 miles to the Loa River. The Loa here is separated from Chuquicamata by a valley eight miles wide and a range of hills through which there is a pass above the mine at El. 10,165 feet.

The combination of latitude, altitude, mountain ranges and air currents produces peculiar weather conditions which profoundly affected the cost of the work.

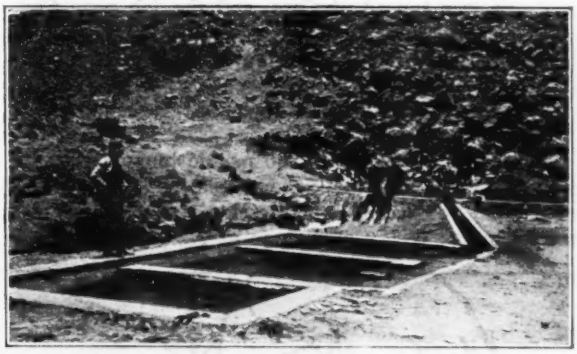

FIG. 1. BEGINNING OF PIPE LINE AT TOCONCE SPRINGS

The springs flow from the lava toe into a pool formed by a low dam; thence to a settling chamber; the pipe line leads from the bottom of the chamber in the foreground

Midday was generally unpleasantly warm; the nights were always cold (frost six months in the year in the lower parts and every month near the springs); it was seldom cloudy and there was no rain except on the upper 10 miles near the springs, where rain and snow were not uncommon in January, February and March. Practically every afternoon high winds swept across the region from the northwest, carrying along all the loose sand and dust of the desert, and making work very unpleasant and at times quite difficult. Rain and snow fall on the high surrounding peaks during the summer months, and in the upper end of the valley there is sparse, coarse, brown grass and some sagebrush and giant cactus. In moist places above El. 13,000 ft. there is a peculiar plant called "yareta" which is the only fuel of the region. It is practically solid wood, grows

to 3 ft. high and 10 ft. across (averages 2 ft. high and 5 ft. across), has the appearance of rounded moss-covered boulders, and is very resinous. It burns readily when dry.

The sides of the valley are formed of volcanic flow from the big peaks of the surrounding mountain ranges, several of which are still smoking. These flows range from loose, gravelly earth to very hard, black traprock, and are from 100 ft. to 2000 ft. in thickness. The floor of the valley is composed of wash from the steep, surrounding mountain sides; this looks as fresh in some places as if it had been deposited last week; while other parts are covered with flat strata of limestone, rock salt or gypsum. The whole Salado River Valley has an area of about 1500 square miles and, outside of the village of Chiu Chiu, has a population of some four hundred, all native Indians, in five villages.

There are several small springs and one large one, besides Toconce, in the valley. The large one, Turi, is at the foot of Mt. Paniri, near the pipe line at K65; has a flow of about 10 sec.-ft. of gaseous mineral water, good to drink while fresh, and well liked by the thousands of llamas, burros and sheep that live on the flat Turi plain watered by it. The Toconce River, flowing from Toconce and other nearby springs, and the ooze from beneath contiguous volcanic rock, are potable. The Loa River, crossing the pipe line at K32, is the principal stream of that part of Chile. It has an average low-water flow, including the Salado, of 90 sec.-ft., is only slightly salty, is used by the natives and on this job was used for all domestic purposes. The A. to B. Railroad Co.'s line was tapped at Cere, and the job near Chuquicamata was supplied from the plant. From these four sources of supply all the water for use on the job was carted or packed. Water-supply was one of the most expensive and difficult items in the construction of the pipe line.

It was determined that 3000 metric tons of water a day (1.225 sec.-ft.) would be ample for all purposes for several years, and a concession was obtained for that amount. With the springs at El. 13,435 ft. (see plan and profile, Fig. 2), the tank above the mine at El. 10,165 ft., and a long distance between, running from below 9000 down to 8000 ft., it was desirable to use as low a hydraulic gradient as possible without making the cost prohibitive. An investigation indicated 9-in. pipe for the larger part of the way with 6-in. pipe down the two principal slopes, near the springs and near the plant. It was planned to put in a short, temporary section of 2½-in. pipe down the mountain near the springs to throttle the flow and keep the pipe full everywhere until the roughening interior of the pipe should bring the hydraulic gradient to the slope used in the calculations for final flow, when the 2½-in. pipe would be removed and replaced by 6-in.; but on account of delayed delivery the job was completed without it.

There is only a short section of the line (on the Turi plain) where the ground is ever wet, and this is always wet. It was therefore decided to use regular rolled-steel pipe, the 6-in. of standard weight and the 9-in. of two weights, 42 and 34.612 lb. per foot, to work at 900 and 600 lb. and tested to 1600- and 1000-lb. hydraulic pressure per square inch. The final location profile indicated that some of the lighter weight 9-in. pipe may have to sustain pressures slightly in excess of 600 lb. per square inch but not high enough to cause concern.

The zero station of the location was taken at the service tank immediately above the camp and plant. Passing from that point towards the springs the line runs down a steep grade, crosses through a divide and climbs into the gap in the range of hills above and east of the mine, where two reinforced-concrete storage tanks of 1500 metric tons capacity each (61½ ft. in diameter by 18 ft. net and 20 ft. gross depth) were located at K6.211 and K6.303 (Fig. 3). From the tanks the conduit passes down a narrow, winding, steep, little hollow for 3 km., then across a fairly even surface continuing down grade to K19.655, east of and beyond the A. to B. R.R., to the lowest point on the line. Thence it runs over an apparently level but gradually rising plain across the valley to the Loa River cañon at K32.058. It there drops into a gorge more than 300

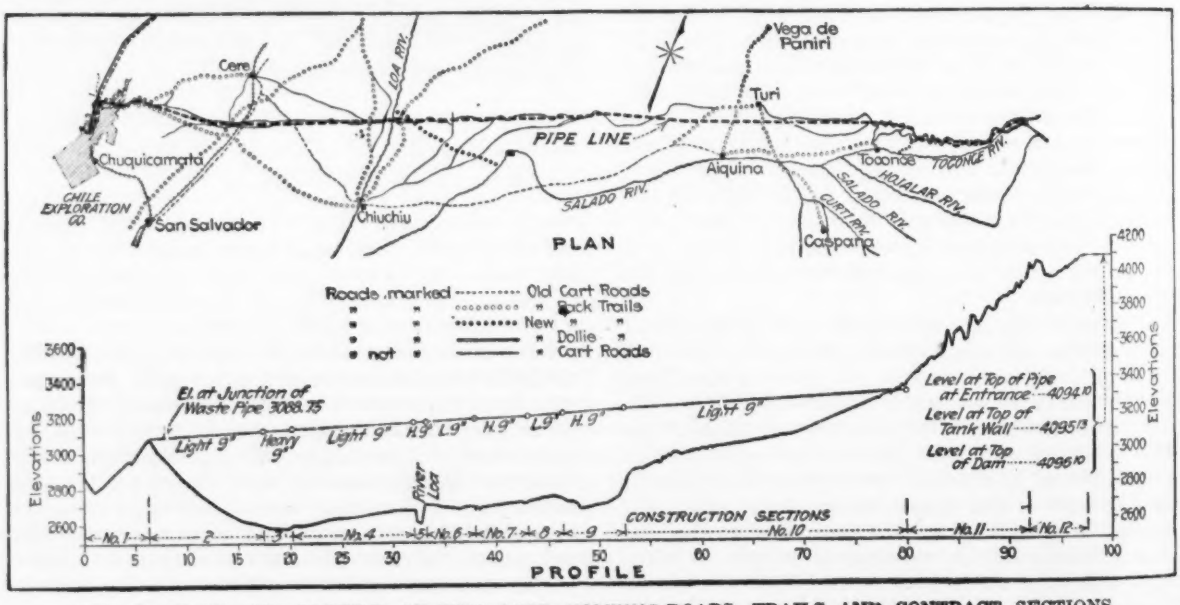

FIG. 2. PLAN AND PROFILE OF PIPE LINE SHOWING ROADS, TRAILS AND CONTRACT SECTIONS

FIG. 3. CONCRETE TANKS AT LOWER END OF PIPE LINE

ft. deep to the greatest hydraulic head on the line, crosses the river and climbs the steep eastern slope to another comparatively flat plain that extends to K78, broken here and there by gullies ranging from a few feet in width and depth to four miles in width and 500 ft. in depth, this largest gully, an ancient watercourse, being known locally as the "sink." The whole floor of the sink is covered with apparently bottomless sand, providing the most difficult hauling problem on the job. From K78 to K84 there is a gradually increasing slope up over deep gullies and steep, sharp ridges. From K84 to the end of the line at K97.569 the conduit runs through country that is extremely rough and variable.

The superintendent of the pipe-line construction reported directly to the resident engineer, and had charge of all work connected with the job except the technical work of the telephone line and calibrations of flow in the pipe, which were done by the mechanical and electrical superintendent. The executive staff consisted of a business manager, two material clerks and forwarding agents, necessary engineers sent out from Chuquicamata when needed and several foremen as the work required. The maximum number of employees was a little over 500. On account of the severe living conditions only the roughest labor element, most of it part Indian, was attracted to the work. The Government authorities coöperated with the superintendent and the resident engineer to prevent the sale of intoxicants along the line, and the job was completed with no serious difficulties among the men and no deaths from violence. The apparent labor turnover ran as high as 100% a month, but much of this was due to men quitting and spending their pay and going back to work within a few days.

The superintendent established headquarters at Chiu Chiu, a village of about 200 inhabitants, at the only practicable crossing of the Loa River, four miles south of the pipe line and 20 miles from Chuquicamata, but the most convenient location from which to reach all parts of the line quickly. The business manager lived with him and had charge of all local business matters connected with the job; smaller contracts, payrolls, supplies, etc. One material clerk was located at Cere, a water station on the A. to B. R.R., which was made the receiving and despatching station for practically all pipe-line material. The other material clerk was located at Chuquicamata and had charge of obtaining and despatching all supplies from the plant.

At the beginning of the job there were so-called cart roads from Chuquicamata to Chiu Chiu via Cere and San Salvador and a semblance of one from Chiu Chiu to Aiquina. On the rest of the line there were only pack trails, and for the last 10 miles the trail was of the most elementary sort. Before other work could be started, then, it was necessary to build passable roads. Up to K77 the only difficulties encountered were (1) making the first Salado River crossing fordable and building a road up both banks; (2) building a road up onto the Turi plain opposite K60; (3) building a road down into and up out of the sink at K52 and K48; (4) building a road from K52 to K62, thereby avoiding a detour of two days for carts, and (5) building a road from K74 to K77 over comparatively easy country. From K77 to the Enganche at K83 a cart road was built over very difficult country made up of deep gullies and steep hills, and all at as steep an ascending grade as practicable, rising 1150 ft. in four miles in spite of the many down grades necessary in crossing the gullies. From the Enganche to the end of the line the cost of a cart road would have been prohibitive, so a narrow road was cut in the mountain side (Fig. 4) and pipe dollies

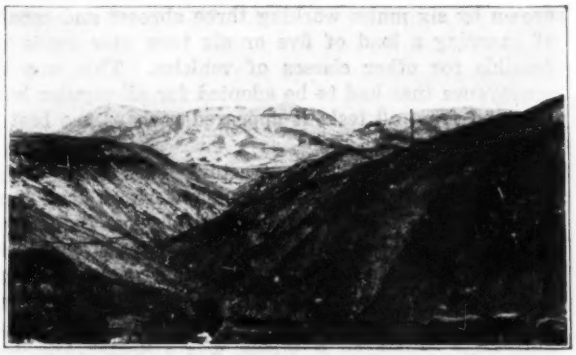

FIG. 4. NARROW ROAD CUT IN MOUNTAINSIDE

The pipe line and dolly road are at the left and the main cordillera in the background

were designed and built suitable for use there (Fig. 5). This completed the roads along the line, but four miles of pack trail was built to reach water for some sections. These were not first-class roads in any sense (except the local conception of a cart road) and three repair gangs were employed regularly for four months during the heavy hauling period. Many more miles of cart road and trail were used regularly, but they were on even ground where no work was required to prepare them for use.

FIG. 5. SIX-MULE CART LOADED WITH 9-INCH PIPE

On the longer trips an extra mule was led to "take turns"; some round trips required six days—for these food and forage were carried on the carts. Dust was an ever-present annoyance

The intention was to do the heavy hauling with tractors. Two 120-hp. Holt tractors and twelve 5-ton trailers were ordered. Owing to war conditions, delivery was delayed, and the machines were not exactly according to specifications, so that they were tried out only near the end of the job and too late to make the changes necessary to adapt them to the country. The low-wheeled trailer, properly designed for use on hard roads or paved streets, sank to the axles in the sand of the sinks, and it took two tractors to haul one trailer with a seven-ton load there. Trailers with 5-ft. wheels having narrow tires and tractors with the slow speed of a mile an hour might have worked. Auto trucks were tried out for the general hauling (there were not enough available for all hauling) and one trip eliminated all but the "quads" which were used throughout the job on a regular twice-a-week provision service from Chuquicamata to Cere and on many special trips for camp moving, quick delivery of special parts, etc. The superintendent used a Ford and in it easily and quickly reached all parts of the line up to K83, beyond which point a mule was necessary. The local cart of the native is a heavy, two-wheeled vehicle, usually drawn by six mules working three abreast and capable of carrying a load of five or six tons over roads impossible for other classes of vehicles. This was the conveyance that had to be adopted for all regular hauling, and from all tests it appeared perhaps the best in any case.

Several local native contractors, each with a few carts, were employed for as much work as they could do but, in spite of the comparatively low daily rates which they could make because they were at home and produced their own forage, they proved expensive; and when working on contract at fixed prices their slowness made other work expensive. The principal carting contractor, Hutcheon & Weiss, was a Scotch-American firm which had had 18 years' experience in similar work on the highlands of Bolivia and Chile and whose scientific management not only made money for its members but reduced cost to the employer.

Pipe and other materials were carted to all points up to K83, except across the Loa gorge, about four tons to a load. (See Fig. 5.) Beyond that point all pipe was hauled one at a time on dollies (Fig. 6) and other supplies were packed on mules. Some of the dollies were improvised from wheeled scrapers; others were made entire in the company's shops at Chuquicamata. Transportation of water was by cart where possible, each cart carrying 8 bbl. of 40 gal each; elsewhere it was by pack mules, carrying four 5-gal. cans each.

Because of the practically uninhabited and unwatered nature of the region, the company boarded all employees on pipe-line work, a practice not used at the plant, where there was a large commissary. The company furnished tents, all food supplies, cooks, water, etc. The employees furnished only their bedding. It might have been better for the company to have furnished bedding also, maintaining a proper renovating plant, as sometimes the men did not (often could not afford to) provide sufficient bedding and consequently suffered with the cold and discomfort and were less efficient. All supplies were taken at first from the company's store at the plant, hauling them in trucks to Cere; but later it was found advantageous to buy from merchants in Calama and Antofagasta, shipping by rail to Cere, taking from the company store only fresh meat and such other articles of less importance as could not be obtained elsewhere. This saved some freight, all the trucking, delay and store overhead, which, in the total, were considerable.

FIG. 6. PIPE DOLLY USED IN MOST MOUNTAINOUS SECTION

The wheel gage is narrow and the pipe is slung high to save road-building work

The superintendent had a permanent camp in a rented house at Chiu Chiu; one material clerk lived in a permanent camp built for the purpose at Cere; the engineers had a movable tent camp that was set up near the work in hand, and each foreman had his own tent camp which was moved about every three miles as the work progressed.

The telephone-line construction was begun at the same time as the first grading for the pipe line and pushed to completion as rapidly as possible. Wooden poles had often failed in this region from a sort of dry rot at the ground surface. They were practically unobtainable, and when they could be got the price was excessive—above $14 each. It was therefore decided to use concrete poles where possible. They were used throughout except for 200 old pipes and two old rails which were on the roughest part of the upper end of the line. The concrete poles were 6 x 6 in. at the bottom, 5 x 5 in. at the top, and 18 ft. long, with corners beveled 1 in. They were reinforced with four ½-in. square deformed steel bars, one near each corner, tied together with iron hoops from used cement barrels. The concrete was composed of 1 cement to 4 ore tailings (voids averaged 22% in tailings) and were cast at the plant on a concrete platform built for the purpose, using wooden side forms. The cost was $10.25 per pole. The concrete was mixed in a 6-ft. mixer, and the poles were strong enough to handle in three weeks.

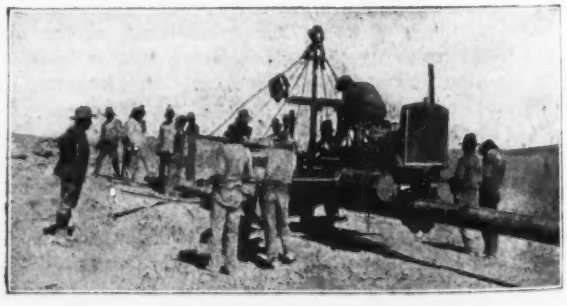

FIG. 7. LAYING PIPE BY MACHINE

An average gang of 26 men laid an average of 60 lengths of pipe a day with a 50-horsepower machine

They were shipped to Cere by rail and carted from there, like the pipe. They sustained very few breaks and seem to be standing up to their work perfectly. A few 24- and 30-ft. poles were made for special cases. They were of the same materials and dimensions as the 18-ft. poles except in length. Poles were set an average of 3 ft. in the ground, 16 to the kilometer (205 ft. apart, average) and across the Loa cañon the wires were suspended from a ⅝-in. wire cable. Much repair work during the progress of the job and a general over-

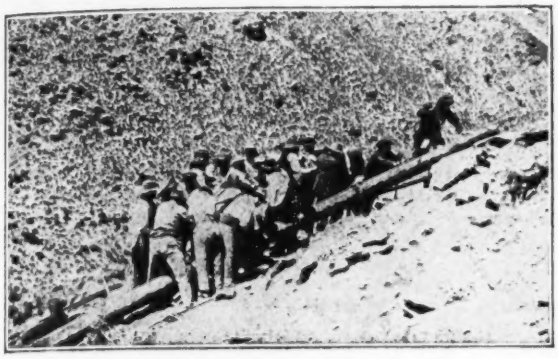

FIG. 8. LAYING PIPE WITH CHAIN TONGS BY HAND
An average gang of 19 men laid an average of 25 lengths of pipe a day

hauling at the end were made necessary by breaks caused by shooting on the grade, but the construction of the telephone line ahead of the other work was justified by the assistance which it rendered to the other work.

Uninterrupted flow through the pipe line is very desirable, as the whole plant operation depends on this water and the storage tanks hold only one day's flow (two days' requirements at present). Great care was taken, therefore, to eliminate all humps that might contain air, and thus obstruct the flow. Where they could not be eliminated, air valves were installed on the line. All low points were provided with scour valves for removing sediment from the line. The great daily range of temperature (as much as 70° F.) would overstress an exposed empty pipe. Careful experiments showed serious strain when the pipe was buried 18 in., and that minimum depth of cover was adopted. Grading was expensive on account of the hard limestone on the surface of the plains and the black trap or "nigger-head" rock found on much of the mountain slopes. In covering the pipe no attempt was made to fill the deeper ditches—only to get a minimum covering. Where there had been no excavation earth for covering, the pipe was scraped up from the surface of the ground nearby. In some places it was necessary to build stone terraces for considerable distances to hold the pipe on the mountain sides; in others stone walls were built across short, deep gullies to save the bends that would have been necessary in following the profile of the ground. The deeper and wider gullies were crossed on wooden trestles, the smallest of which had two 3-m. and two 2-m. bents; the largest, one 2-, one 3- and seven 7-m. bents. The Loa River was spanned by a steel truss bridge 60 ft. long, the interesting feature of which was its erection ahead of its foundations, the bridge being suspended complete on tripods at the ends, the anchor bolts and tie-rods placed and the concrete foundations poured.

A pipe-laying machine was used on the smoother parts of the line, and the pipe in the rougher country was laid by hand, using chain tongs. Laying pipe by machine required an average gang of 26 men, which averaged laying 60 joints of pipe a day, with a maximum of 150. A hand-laying gang of 19 men averaged laying 25 joints of pipe a day, with a maximum of 40 on 9-in. and 45 on 6-in. pipe. These figures could have been very materially increased if experienced pipe men had been available. The men employed, including the foremen, were without any previous training in pipe work.

When the line was put into service, trouble developed in the machine-laid pipe, 14 joints pulling out, apparently due to crossed threads which stripped in laying. One pipe split. No leaks of importance occurred in the hand-laid pipe. Preparations had been made for these emergencies, and 2-ft. sections of pipe, flanged both ends with an extra pair of flanges each, were on hand. In every case, the damaged end of pipe was cut out, the cut end threaded and flanged and the flanged section inserted. A few small leaks were calked with a chisel. In spite of painstaking precautions, a number of foreign objects were discovered in the pipe when water was turned in—small stones and pieces of wood up to 4 x 6 in., several feet long. They were removed at the scour valves, the pieces of wood by splitting up with a chisel and hammer into pieces that could be taken out.

Measurements of flow through the whole length of the line were not completed, but a fairly satisfactory set of measurements was taken on the 9-in. section immediately below the springs. A venturi meter, required by the Government of Chile, was installed near the intake where the head would be 12 ft. at ordinary flow; a gate valve, the only one on the line, was placed just below the meter; the intake and settling chambers were carefully measured; a weir was built in the intake, and pressure gages were attached at suitable places along the line. The measured flow did not follow any known formula exactly. The observed variation of the hydraulic gradient with the velocity, compared with the computed variations, is shown in Fig. 9. The original computations were based on Kutter's formula, which indicated a hydraulic gradient of 0.5% in the 9-in. pipe, and the observed slope at 3000 metric tons per day was 0.325 per cent.

Owing to the low hydraulic grade, some air valves

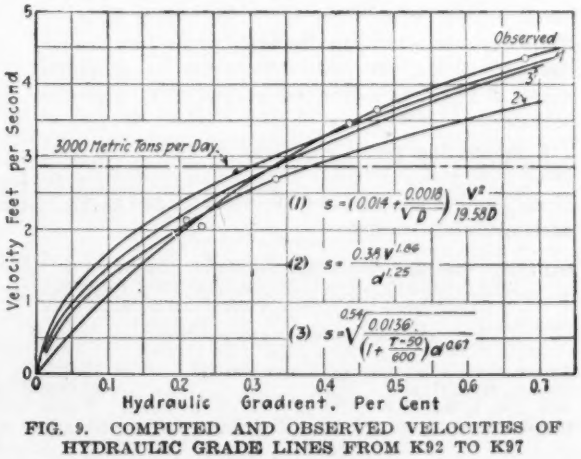

FIG. 9. COMPUTED AND OBSERVED VELOCITIES OF HYDRAULIC GRADE LINES FROM K92 TO K97

were left above the gradient, to admit air to the line. The velocity of the water is sufficient to entrain this air, and it is carried along to be discharged—small amounts at air valves, but principally at the tanks. Possibly due to reduced volume of entrained air under high pressure, as well as the dips into deep gullies, the hydraulic gradient of the inverted siphon between K6.303 and K79.900 does not appear from the incomplete pressure-gage readings to be a straight line.

To provide a cutout so that work might be done on the tanks, or for other reasons, without shutting off the flow through the pipe line, the overflow shown in Fig. 10 was devised. The friction head used in the design was the same as calculated for the pipe, 0.5%, but the expanding entrained air, acting as an air lift, caused water to overflow here when the surface of the water in the tank was 4 ft. below the overflow pipe. To correct this, the arrangement shown in the same figure was installed and worked perfectly, the air-lifted water never getting higher than 6 in. from the top of the little tank.

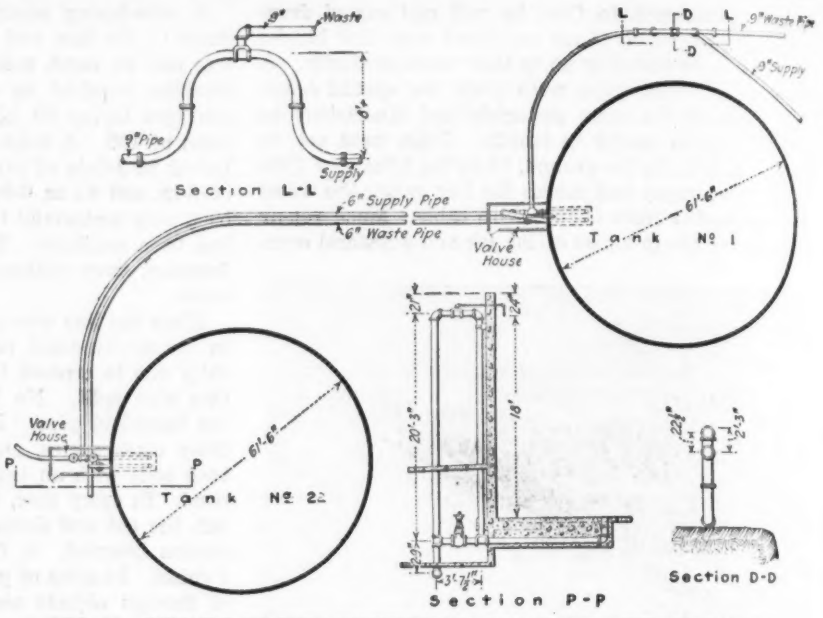

FIG. 10. DETAILS OF PIPE CONNECTIONS FOR WATER-SUPPLY TANKS

It was the intention of the tank design to have the tank at K6.303 serve as a reservoir and that at K6.211 serve as a buffer; that is, the former would always stand full of water and the latter would deliver water to the line when the plant demand was in excess of the delivery to the tank or receive water from the line when the demand was less than the supply, the excess overflowing and wasting from the latter tank. The siphon overflow shown in Fig. 10 was devised to give close control of the water level, without using large pipe or giving opportunity for foreign bodies to enter the pipe. It also saved any opening through the tank ring. The connection, closed with a valve, at the bottom, permitted this same pipe to be used as a wash-out. Water commenced to overflow when its elevation in the tank was 18 ft. At about 18 ft. 2 in. the overflow was greater than the inflow, and the overflow continued until the water level in he tank was about 3 in. below the end of the air inlet. This can be prevented by using a 1½-in. pipe instead of the 1-in. pipe now in service.

Some of the most important costs on the job, and those that would be most valuable in estimating on another similar job in a similar country, are given in the accompanying tables:

SALARIES, WAGES, CAMP COSTS, CARTING COSTS, WORK DONE -PER MAN-DAY, AND COST DISTRIBUTION BY PERCENTAGES ON TOCONCE PIPE LINE, CHILE

Standard Rates of Wages and Salaries

Laborer, $6 m/c equal, at average exchange for 1918	$1.68 U. S.
Foreman, $10 to $18 m/c	$2.80 to $5.05
Mess cooks, $8 to $10 m/c	2.25 to 2.80
Gold roll foremen	$150 to $225 per month

Camp and Maintenance Costs

	m/c	U.S. Currency	%
1. Labor—cooks, helpers and odd men	$0.5518	$0.1552	10.2
2. Miscellaneous mess supplies—candles, utensils, etc	.0437	.0123	0.8
3. Food cost at supply base	3.3340	.9365	61.6
4. Fuel—yareta and oil	.2385	.0674	4.3
5. Carting, including water and forage	1.0780	.3033	20.0
6. Overhead—Chuquicamata only	.1673	.0470	3.1
Total mess charges	5.4133	1.5217	100.0

Of item 5 above, 55%, or $0.17 United States currency, per man-day, was for water transportation alone.

Officers' mess as averaged	$7.35	$2.06 per man-day
Work camp mess as averaged in the seven main camps	3.97	1.11 per man-day

Average Daily Ration—Work Camp

(Based on a close analysis of the foodstuffs supplied, as shown in item 3, above)

No.	Item	Price, m/c	Amount	Cost, m/c
1.	Beef	$0.807 lb.	14 oz.	$0.706
2.	Charqui (dried beef)	.987 lb.	11-12 oz.	.056
3.	Potatoes	.183 lb.	1¼ lb.	.017
4.	Sugar	.396 lb.	9 7/10 oz.	.240
5.	Rice	.527 lb.	5½ oz.	.173
6.	Onions	.186 lb.	3 7/10 oz.	.043
7.	Canned vegetables, tomatoes, string beans, peas	.051 each	1/10 can	.095
8.	Garlic	.051 each	⅛ each	010
9.	Cereals; trigo mote, semola, chuchoca, frangolla, pea flour	.312 lb.	10 8/10 oz.	.213
10.	Fideos (spaghetti)	.528 lb.	3¼ oz.	.110
11.	Quaker and gavilla oats	.916 lb.	1¼ oz.	.095
12.	Lentils and beans	.533 lb.	5½ oz.	.175
13.	Salt cod and shrimp	1.740 lb.	½ oz.	.018
14.	Canned salmon and sardines	1.089 can	1/10 can	.109
15.	Dried peaches and figs	.264 lb.	3 13/16 oz.	.064
16.	Lard and grease	1.061 lb.	1 1/10 oz.	.125
17.	Olive oil	.310 liter	1/10 liter	.003
18.	Coffee	1.140 lb.	1 oz.	.071
19.	Tea	3.236 lb.	¼ oz.	.026
20.	Milk	1.337 can	¼ can	.167
21.	Pepper and spices	1.606 lb.	7/10 oz.	.070
22.	Salt	.097 lb.	1¼ oz.	.010
23.	Bread, three marquettes	.100 each	3 each	.300
Total cost of daily ration				$2.947 m/c

Total cost of daily ration	$0.829	United States currency
The officers' messes cost per daily ration	6.980	m/c
The officers' messes cost per daily ration	$1.960	United States currency
Average for the whole job was	3.334	m/c
Average for the whole job was	$0.938	United States currency

It must be understood that this was not a fixed ration, or what was believed to be ideal, but what could be had at the time; that all the items enumerated were never present at any one time in any camp; that local market limitations and transportation often left the camps with very meager supplies of any kind, and

that the object was to give the men substantial and fairly palatable food that would keep them in condition to do the hard work and withstand the rigorous climate.

Of the above ration, items 8, 11, 13, 14, 19 and 23, totaling $0.693 m/c, were bought largely from foreign markets, and the cost was high, though not particularly variable. The remainder of the ration was from local markets and consequently its cost in United States currency was affected by the temporary low value of the American dollar, which normally is worth near five Chilean pesos instead of the 3.56 average used in this statement. The average amount of water requirement per man-day was 2½ gallons.

Pipe Carting Costs, in United States Currency

Section	Per Metric Ton-Mile	Per Short Ton-Mile	
		Mile	
1	$10.44	$5.23	Near camp and mine; no road
2	7.85	1.38	
3	8.56	3.04	No roads.
4	7.28	1.18	
5	12.88	1.06	
6	14.02	.75	
7	16.30	.74	
8	16.85	.68	
9	24.20	1.85	Sink.
10	40.00	1.19	
11	63.20	1.17	
12	74.20	1.26	
Average	28.22	1.18	

Total Quantities of Work Done and Amounts per Man-Day

Owing to the varying rates of exchange it would be difficult to prepare a table of cost of labor on different classes of work, but the following statement of amount done per man-day should serve the same purpose.

Grading:	Lineal Meters	Cubic Meters	Cubic Yards
Total	97,306.00	95,949.00	112,478.00
Per man-day	2.34	2.07	2.72
Covering pipe:			
Total	97,306.00	61,788.00	80,780.00
Per man-day	4.84	3.07	4.02
Laying pipe by hand:			
Total	36,149.000		(17,920 of 6 in.; 664 of 8 in.; 17,565 of 9 in.)
Per man-day	693		
Laying pipe by machine	61,328.00		
Per man-day	906		

Making telephone poles; all labor, including making concrete casting platform, cutting and placing reinforcement; mixing and placing concrete; making, placing and removing forms, and removing from the platform and stacking up 1,444 18-ft. poles, 1.52 poles per man-day.

Division of Cost Items by Percentages for Entire Job

	Per Cent.		Per Cent.
Labor	13.26	Superintendence and Engineering	2.81
Materials	49.91	Overhead (Chuquicamata)	6.83
Plant and tools	1.88	Other expenses	4.56
Camp and maintenance	10.54		
Carting	10.21		
Total			100.00

Construction, except preliminary work, was begun in November, 1917, and completed in March, 1919. S. B. Williamson, now consulting construction engineer for the Chile Exploration Co., New York City, was construction engineer until he went to France as colonel and section engineer, A. E. F., when he was succeeded by H. O. Cole. H. C. Bellinger was general manager; H. Harvey, resident engineer; L. A. Greenley, assistant engineer on preliminary investigations; George S. Witmer, mechanical and electrical engineer; T. N. Mize, superintendent; Louis H. Mohr, business manager of the pipe line; and the writer was assistant resident engineer in charge of construction.

Lack of Foresight in Municipal Water-Supplies

Planning for the Future and Even Provision for Current Needs Are Safeguards Against Emergencies Often Neglected

By Morris Knowles
Consulting Engineer, Pittsburgh, Penn.

IN CONNECTION with his work as supervising engineer for Camps Meade and McClellan, and later as Chief Engineer of the Housing Department of the Emergency Fleet Corporation, the writer had occasion to investigate a considerable number of existing municipal water-supply systems, and was impressed with the general lack of forehandedness in planning such work, judging by reasonable engineering standards.

The standards adopted by the Cantonment Construction Division and the Housing Department of the Emergency Fleet Corporation were based on sound engineering principles and practice, applied with reason and moderation, for the emergency of the situation required that many of the finer points of good design should be neglected. Nevertheless, it was strikingly true that a large number of the municipal systems investigated fell far short of the requirements of these moderate standards. This was even true in many cases in considering the adequacy of the system to meet existing demands, without any allowance whatever for the additional demands proposed to be put upon them by the developments of the Army and the Fleet Corporation.

As an example, at a town adjacent to one of the Army cantonments it was found that the entire community was being served by a single motor-driven centrifugal pump operating 24 hours a day, without any provision whatever for spare equipment in case of a breakdown. In a city where one of the Fleet Corporation's developments was carried out, a grossly polluted river supply was found in use, and the influence of the Shipping Board was necessary in order to prevail upon the city to pass a bond issue for installing a purification system.

Examples of this sort might be multiplied almost indefinitely, but they would serve only to give additional emphasis to the necessity for planning in advance and for good engineering advice even in the development of small water-works systems. An adequate supply of wholesome water is as essential to a small community as to a large one.

The small community of today is the large one of tomorrow. Conformity to the standards of good practice and provision for growth of population and increased consumption per capita require careful study. At the same time, true economy is subserved by foresight, as could be illustrated in many instances by the excessive cost of obtaining right to additional supplies or of securing property to guard against contamination because of failure to make proper provision in the first place; or by the great expense involved in rebuilding an entire plant because of failure to leave sufficient space for the installation of purification systems and of additional pumping units when required.

It should be remarked, however, that this lack of foresight in planning municipal water-works systems is but one phase of the large problem resulting from the general lack of foresight in planning city and town developments. A water main of inadequate diameter is often accompanied by congested traffic in the street above; lack of sufficient water is frequently only one phase of bad housing conditions. The problems are related and analogous, and careful study, farsighted comprehension and definite planning are essential to the solution of both.

Grants Made for British Roads

The highway authorities of Great Britain, according to a report received by the Bureau of Foreign and Domestic Commerce, has made grants, to July 31, 1919, amounting to $45,500,000 for the repair of roads and bridges in the British Isles. This grant was divided as follows: England, $39,240,000; Scotland, $2,640,000; Ireland, $645,000; Wales, $2,975,000.

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Herbert Clark Hoover

Hoover Acclaimed as Genius of Constructive Administration by Fellow Engineers

Food Administrator, at Testimonial Dinner by American Institute of Mining and Metallurgical Engineers, Discusses Present European Conditions

HAILED as one of the outstanding figures of the war and as the man whose achievements best typify the definition of engineering as "the art of organizing and directing men and controlling forces and materials of nature for the benefit of the human race," Herbert C. Hoover, back in this country after five years' direction of American relief overseas, received an enthusiastic welcome from 1200 fellow members of the American Institute of Mining and Metallurgical Engineers, at a dinner given in his honor Sept. 16, 1919, in New York City. The assembly of engineers, according to W. L. Saunders, past president of the institute, who served as chairman of the committee on arrangements and as toastmaster, had been arranged to "extend the welcome due an eminent American citizen, a successful engineer, a genius of constructive administration, a practical economist and a statesman of worldwide vision."

Mr. Hoover, Discussing European Conditions, Says, "Socialism Is Bankrupt"

The social ferment in Europe, the extraordinary lowering of productivity in industry, and the economic chaos created by the struggles of a score of new democracies to establish themselves, formed the opening theme of Mr. Hoover's address. His problem was not a relief problem in the ordinary acceptance of the term. Foodstuffs and other supplies had to be found, not merely for the starving populations of the ravaged regions, but for the whole of Europe, and at the same time Bolshevism had to be warded off in order that newly-born democracies could grow. The consummation of these aims involved the organization of the economic strength of the United States and its coördination with the remaining economic strength of Europe and, in large areas, the imposition of absolute dictatorship over economic forces.

Many of the new governments, Mr. Hoover pointed out, were without experience or even without the existence of departments for the conduct of either the transportation or the distribution of supplies. Thus, it was necessary to secure the erection within their governments of actual departments, to furnish them advisers, to take over the actual operation of thousands of miles of disintegrated railway systems, to open rivers and canals for traffic, to stimulate the production of coal and other primary commodities, to control their distribution through large areas, to find a basis for exchange of surplus commodities from one state to another, to exercise the strongest political pressure to obtain the disgorgement of surpluses into areas of famine, to resort to barter on a national scale where currencies had broken down, to stimulate peoples discouraged and disheartened to efforts in their own salvation, and finally, but not least, to intervene a charitable hand in the saving of their children and the stamping out of contagious diseases; and through all of this economic disorganization to inspire the maintenance of order on one hand, and the defeat of reaction on the other. Beyond this again, the necessity of constant friendly intervention in frontier quarrels to prevent the starting of more wars.

"These things," said Mr. Hoover, "have not been solved by the service or direction of any one man. They have been accomplished through coördination of the men of good will in twenty governments of Europe and throughout by creation of a thread of American personnel, directed from a single center. The proof of their performance lies in the fact that Europe has come through the most terrible period of its history with no loss of life from economic causes, with a stronger democracy and a glow in its heart for the United States. From the armistice to this year's harvest there has been furnished over $2,250,000,000 worth of supplies, the majority of which has been given freely upon the undertaking of the assisted governments of repayment at some future date.

"We require only a superficial survey to see that the outstanding and startling economic phenomenon of Europe today is its demoralized industrial production. Of the 450,000,000 people in Europe, a rough estimate would indicate that they are at least 100,000,000 greater than could be supported on the basis of production, which has never before reached so low an ebb.

"It is true that some of this diminution in production has been contributed to by the other factors; but in the larger degree the cause of this steady decrease of productivity, with its shortage of necessary supplies and its rising cost of living, must be sought in the social ferment, with its continuous imposition of Socialist ideas. In this ferment the advocates of Socialism or communism have claimed alone to speak for the downtrodden, alone to bespeak human sympathy, and alone to present remedies, to be the single voice of liberalism.

What Happened in Russia

"We may examine these phenomena a little more closely. In Russia we have a great country in which the population, with the exception of a small minority, were comparatively well fed, warmly clothed and warmly housed. They were subject to the worst of political tyranny, were deliberately steeped in ignorance and superstition, yet their productivity was sufficient to enable them to provide these primary comforts and to export more foodstuffs than the United States. Socialism was brought in over night at the hands of a small minority of intellectual *dilettante* and criminals, and this tyranny of minority, more terrible even than the old, has now had nearly two years in which to effect the conversion of the wicked competitive system into the elysium of communism. Two-thirds of the railways and three-fourths of the rolling stock that they control are out of operation. The whole population is without any normal comforts of life and plunged into the most grievous famine of centuries. Its people are dying at the rate of hundreds of thousands monthly from starvation and disease. Its capital city has diminished in population from nearly 2,000,000 inhabitants to less than 600,000.

"If we examine the recent proclamations of this group

of mixed idealists and murderers, we find a radical change in their economic and social ideas. They have abandoned the socialization of the land, for they find the farmer will not produce for payment in high-flown and altruistic phrases. They have reëstablished a differential wage, in an attempt to stimulate exertion and ambition of skilled labor. They have established a state savings bank, in order to stimulate production through making provision for family and old age. They are offering fabulous salaries for men capable of directing the large agencies of production. In fact, while in the midst of flowery verbal endeavor to maintain that they are still Socialists, they are endeavoring to restore individual ownership of property and of the results of labor. The very high priest of Socialism is today vainly endeavoring to save his people from their total destruction by summoning back the forces of production. The apologists of this *débâcle* are telling us that it is due to the allied blockade, and to various other oppositions, but anyone with a rudimentary knowledge of Russia knows that they did have within their borders ample supplies of food, coal, oil, wool, flax, cotton and metals and the factories with which to work them in abundance, and that their sole deficiency is human effort.

"We could take another example of Bolshevism in the efforts of Bela Kun and his colleagues in Budapest. The distinction between this situation and the one in Russia is that they were dealing with a population of much higher intelligence, of much higher average education, and it required but three months for the working people of Budapest to realize the fearful abyss into which they had been plunged. It was solely due to the efforts of the trade unions in Budapest that the Bolshevists were thrown out of Hungary.

Tide Turning Against Socialism

"These are the extreme points where Socialism has had its opportunity for immediate and wholesale application, according to all of the precepts of its advocates. Elsewhere in Europe Socialism has proceeded through established institutions, and we may shortly examine the results here also. During the war large measures were taken on both sides of the front to secure the mobilization of production and distribution to its maximum use in the struggle. There was effective socialization of vast sections of industry. These measures are being continued and extended today in many places by governments anxious to maintain the stability of institutions even at the sacrifice of economic safety, but under the threat of minorities of revolutionary action. Yet here again the same prime weakness has proved itself. The only partial success of these measures in war was due to the great, patriotic impulse of war. Those who conducted these large operations were men whose initiative and capacity had been selected by the competitive system. These war impulses have been lost, and these organizations with constantly decreasing efficiency even in war now face disaster from further reduced productivity. All these decreases have immediate results in a rising cost of living or the necessity of governments to subsidize commodities—such as bread. There is no better example of this than the coal industry of Europe, and—even omitting Russia—this production has fallen from a rate of 600,000,000 tons per annum at the armistice to a rate of 450,000,000 tons recently.

"The whole of these various sorts of Socialism are based on one primary conception, and that is that the productivity of the human being can be maintained under the impulse of altruism and that the selection of the particular human for his most productive performance can be made by some superimposed bureaucracy. Their weakness is the disregard of the normal day-to-day primary impulse of the human animal—that is, self-interest for himself or for his family and home, with a certain addition of altruism varying with his racial instinct and his degree of intelligence. They fail to take into account, also, that there is but one sufficiently selective agent for human abilities in that infinite specialization of mind and body necessary to maintain the output of the intricate machinery of production, and that is the primary school of competition.

"My emphatic conclusion is, therefore, that Socialism as a philosophy of possible human application is bankrupt.

"Bankruptcy of the Socialist idea, however, does not relieve us from the necessity of finding a solution to the primary question which underlies all this discontent, and that primary question is the better division of the products of industry and the steady development of higher productivity. This bankruptcy of the Socialist idea should, if reaction is to be prevented, return the guardianship of this problem from the radical world to the liberal world of moderate men, working upon the safe foundations of experience.

Solution Must Be American

"The paramount business of every American today is this business of finding a solution to these issues, but this solution must be found by Americans, in a practical American way, based upon American ideas, on American philosophy of life. We can well see a vivid confirmation in Europe of the fundamental economic principle that the standard of living and the cost of living is the direct quotient of the amount of commodities produced; that we must secure a maximum production of the industrial machine if we wish to keep our population alive or see an increase in the standard of living of our people.

"If I were thinking aloud I would say at once that this maximum production cannot be obtained without giving a voice in the administration of production to all sections of the community concerned in the specific problem; that it cannot be obtained by the domination of any one element. I would say that the human race had increased its standards of productivity and therefore of living, through the growth of extraordinarily intricate organization of production and distribution based upon stimulation of the individual by the reward it offers. I would also say that it cannot be obtained from the destruction or sudden disturbance of this delicate and intricate organization of production and distribution or extravagance in its products. I would say the road lies along the better division of the more exorbitant profits that arise from these processes and that have accumulated from them. By better division of profits, I do not refer particularly to profit-sharing schemes but to the broad issue of the whole social product. Some are comparatively overpaid and many are comparatively underpaid for the service they render to the community. Our organization in many aspects is not all that we could desire, but it is the best we have been able to evolve over thousands of years, and the destruction of these processes or of the organization which conducts them has been demonstrated to be the sure road to destitution and fearful loss of life.

"Observation of the forces in Europe has reinforced my Americanism. It has revealed to me the distance of our departure from the political, social and economic ideals of Europe. There has grown in this United States a higher sense of justice, of neighborly service, of self-sacrifice and, above all, a willingness to abide by the will of the majority in every section of the community. This Americanism is the guarantee of the ability of our people to solve this most momentous internal problem confronting our generation. But these very ideals, this very sense of justice and service for our own people give us still further opportunities. Our sister civilization in Europe is today recovering from a great illness. The many new democracies that we have inspired are striving for our ideals. We alone have the economic and moral reserve with which to carry our neighbor back to strength. To do this is also true Americanism."

W. L. Saunders Pays Tribute to Hoover and His Work

From Mr. Saunders' address, introducing Mr. Hoover, the following extracts are taken:

"Never before have men gathered to pay a just tribute of admiration to one who has done the things that this man has done. His work was not built upon precedent; there was no experience, no guide. It was in fact a creation. In the words of the Prime Minister of England, his work in Belgium was nothing less than a miracle. Yet it is a fact that those who have been in close touch with the situation say that his greatest work has been done since the armistice was signed.

"Truly, this is a period of new things, new changes, new times; a period of agitation which brings to the front new men of true worth. You who are mining engineers know what a good thing the flotation process is—how, by violent stirring up of things, the metallic values are separated from the gangue and float off at the top. This process has been in action all over the world during the past five years, and it has revealed out of the chaos an engineer of the value of pure gold.

"Here, at last, we have the example of an engineer who typifies the modern definition of engineering: 'Engineering, the art of organizing and directing men, and controlling forces and materials of nature for the benefit of the human race.' How well this modest mining engineer has shown that he has the art of 'organizing and directing men!' Of the many thousands working for him, here and abroad, it is said that not only have they given him loyal support, not only are they glad to work for him, but every man of them would take off his coat and fight for him. How well he has shown his capacity for 'controlling forces and materials of nature for the benefit of the human race!'

"The engineer is at last coming into his own. We see the dawn of a new day; truly, there is a new order of things. The great centers of the world are now industrial centers. The prosperity and strength of nations in peace and war rest now upon the factory system, the shops, the railways and steamships, the mines, the smelters and the public works. And who is responsible for this? Who plans and executes these things? It is the engineer—civil, mining, electrical, mechanical, chemical and automotive. Such captains of industry are by education and experience best fitted to steer the ship of state. The place for the engineer is not in the dark confines of the hold below, but on the upper deck—yes, on the bridge. We are told that practically all the executive heads of the organization for the relief of Belgium were engineers.

"It was Mr. Hoover who took care that there should be no food shortage. He did more—he taught thrift to millions of people in all walks of life and in all parts of the world. But it is not only in food that our guest stands as an example of achievement; he typifies the engineer, the executive, the man behind the gun.

"Little has been said of Mr. Hoover's capacity to think straight in advance, but this is really one of his strongest characteristics. It was first shown when he took charge of the work of sending Americans over when the great war broke out. His plans were made and negotiations completed with shippers before the organization was made up and before he had any knowledge of how many persons were to go or where the money was to come from. While forming the Commission for the Relief of Belgium, and before he knew who was to pay the bills, he had ordered millions of dollars' worth of food and had chartered ships. When asked why he took such chances he said that it was impossible to believe that the people of the world would not stand behind so wholesome a measure in the interest of humanity, and they did stand behind it nobly and to the end.

"I have said that there was no precedent for the work done by Mr. Hoover. He has established a precedent for engineers, and for us this is one of his greatest acts.

What Hoover Did

"Herbert Hoover is a graduate of Stanford University. He first served with the United States Geological Survey, then went to West Australia and China, in mining activities. His work in London up to the beginning of the world war was notable in that he departed from the usual share-promotion schemes of the mining market, developing the properties in which he was interested purely on technical lines. He began war work the morning after England declared war on Germany, taking charge of the relief of American refugees, advancing funds out of his own pocket, and, through his friends, furnishing 45,000 persons with money and steamer tickets to get home. In October, 1914, he organized the Commission for the Relief of Belgium. Through this source 9,000,000 persons were continually supplied with food, nearly half of them being entirely dependent upon this relief. There were 35,000 Belgians and French engaged with him in this work. He provided 70 steamers in regular service, delivering 4,500,000 metric tons of foodstuffs. The total overhead expenses of this commission were less than one-half of one per cent. He was responsible for the expenditure of $650,000,000.

"Shortly after America entered the war Mr. Hoover was summoned to Washington to take charge of the food situation here. His organization in every state and county comprised 8500 men and women, giving their whole time to the Food Administration. In addition to this there were half a million persons registered and ready to be called upon for emergency work. It has been estimated that this administration carried out its functions, 92% by voluntary effort, 7% by persuasion and 1% by legal authority. A conservative esti-

mate of the advertising voluntarily contributed in this work approximates the sum of $18,000,000.

"Immediately after the armistice was signed Mr. Hoover was directed to proceed to Europe to investigate the part that America could play in the relief of the civilian population. Though he had but four days before sailing he arranged for the purchase and shipment of 250,000 tons of food. It was not until February of the following year that Congress appropriated $100,000,000 for European relief. At that time several hundred thousand tons of foodstuffs had been actually distributed. Up to a recent date over 3,000,000 tons of foodstuffs, valued at over $770,000,000, have been distributed.

"Certain things stand out with striking prominence. Mr. Hoover was more than a food administrator. He was a general, was an organizer in action. He got men to do things. His faith in the moral support of the people was sublime yet practical. He seemed to know the right methods to follow and the psychological moment to act in order to secure the full measure of support."

Purification-Plant Methods and Results at Albany

Sedimentation, Double Filtration, Coagulation and Chlorination Employed—Typhoid Cases Reduced—Unit Cost $12.32

DOUBLE filtration of settled water, with the use of alum at times in connection with the preliminary filters, followed by chlorination with hypochlorite and liquid chlorine used jointly, is the method employed to render the badly polluted and sometimes turbid Hudson River water fit for the supply of Albany, N. Y. The original slow-sand filtration plant, a pioneer of its kind in this country, was built in 1898-9 with Allen Hazen as engineer. Preliminary filters were put in use in 1908, chlorination in 1909 and alum coagulation in 1912.

About 90% of the supply is Hudson River water, filtered and pumped, and 10% is delivered by gravity from small streams west of the city. The amount of filtered water supplied during the year which ended Sept. 30, 1918, averaged just under 20,000,000 gal. a day. The consumption and waste of filtered and unfiltered water for the year, assuming a population of 110,000, was 213 gal. per capita, compared with 192 gal. the previous year. The extreme cold weather early in 1918 is held responsible for the increase. Only about 45% of the taps are metered.

The river water is pumped against 19-ft. head to a sedimentation basin and against 9 ft. from this basin to the preliminary filters. The treated water passes by gravity to the main pumping station some two miles distant.

The sedimentation basin affords from 12- to 18-hour detention. It is not baffled. Alum was applied 34 days in 1917 and 182 days in 1918 to the water before it went to the preliminary filters. Alum is used in times of high turbidity when the water is bypassed around the slow-sand filters. It is also used at times when bypassing in winter, when the amount of required chlorine is larger than can be used at low temperatures. The alum rate ranges from two grains in winter to 4½ grains in summer.

All water passes through the sedimentation basin and the preliminary filters and is chlorinated. From May 1 to Nov. 1, from 5 to 50% of the prefiltered water is bypassed around the slow-sand filters.

As a matter of safety, both hypochlorite and liquid chlorine are used for disinfection, the range in terms of available chlorine being from 0.25 p.p.m. in winter to 1.5 p.p.m. in summer for the two combined. Hypochlorite is applied up to the working capacity of the mixing and dosing equipment, and liquid chlorine to make up the remainder of the demand. The chlorination apparatus is in duplicate.

The 16 preliminary filters have a total area of 0.3 acres and a rated capacity of 70,000,000 to 80,000,000 gal. per acre per day. The eight slow-sand filters have a combined area of 5.6 acres and a rated capacity of 3,000,000 gal. per acre. All the sand in each type of filter is washed by Nichols washers once in two years—half each year. The average length of run of the preliminary filters between ordinary washings in 1917-18 was 34; the average rate of filtration, 76,200,000 gal. a day and the wash water averages 2.7% of the total amount filtered. The slow-sand filters were scraped an average of 6½ times per year in 1917-18.

The cost of operating the entire water treatment plant for the year which ended Sept. 30, 1918, including extra pumping, is shown by Table I, while Table II summarizes the bacterial, physical and chemical results for the same year.

TABLE I. COST OF WATER TREATMENT AT ALBANY, 1917-18

	Per 1,000,000 Gal.
Pumping	$5.76
Sedimentation basin	.02
Preliminary filters	.54
Slow-sand filters	1.21
Laboratory	.90
Sterilization	.83
Alum plant	2.84
Superintendence	.22
Total cost	$12.32

Typhoid fever in Albany from 1891 to 1899, before the purification works were put in use, averaged 426 cases and 71 deaths a year, while from 1900 to 1918 the corresponding figures were 163 cases and 18 deaths, reductions of 76 and 74 per cent.

Wallace Greenalch is commissioner of public works of Albany and J. B. Kilbourn is superintendent of water-works. George E. Willcomb has been chemist and bacteriologist since 1906 except for a year and a half when he was in war service.

TABLE II. BACTERIAL, PHYSICAL AND CHEMICAL RESULTS AT ALBANY WATER-PURIFICATION PLANT, 1917-18

Water	Bacteria per Cubic Centimeter: Gelatine	Agar	Neutral Red Total	Neutral Red Coli.	Turbidity	Color	Total Hardness	Alkalinity	Oxygen Consumed	Ammonia: Free	Ammonia: Alb.
Raw Hudson River water	46,000	1,030	89	24	20	42	73	78	19.1	0.083	0.116
Settled water from basin	37,000	805	...	...	13	39	...	...	17.6	0.072	0.101
Effluent primary filters	10,500	169	...	...	2.9	32	...	...	15.2	0.046	0.050
Effluent secondary filters	1,190	34	4	1	0.1	25	...	...	14.4	0.026	0.031
Water from pure well	52	5	0	0	0.1	25	75	78	14.4	0.026	0.031

The Albany Water-Works a Hundred Years and More Ago

Private Company Formed in 1800 Based First Rates on Number of Fireplaces, but Soon Changed—Pipe Priced at $100 a Ton

AN OLD leather-bound volume in the possession of Wallace Greenalch, commissioner of public works of Albany, N. Y., contains the minutes of the Albany Water-Works Co. for the half century beginning in March, 1800. The company was incorporated in 1802 and continued in existence until the city bought the works for $114,600 in 1851. The following notes and quotations were recently taken from the minute book by a member of the editorial staff of *Engineering News-Record*. The minutes are written in a clear hand, for the most part in concise and forcible English.

Naturally enough, one of the earliest of the meetings recorded was devoted to fixing water rates. This was a meeting of trustees held in August, 1800, at Lewis Inn. It was then provided that for "every house or building containing not more than four fireplaces there shall be paid [sum defaced] per annum," but that the charge against any one private house should not exceed $10 a year. In addition, water rates were to contribute their proportionate part "forever thereafter" toward maintaining the works, except that portion "intended for the use of the city," the costs of which were to be a charge against the two-fifths ownership of Benjamin Prescott and his heirs. This plan was not long followed, for on July 30, 1801, it was resolved that the city should pay $7 a year for the use of water at the city hall, in addition to the usual rates for dwelling houses.

Water-Closets Used But Not Favored in 1803

On Sept. 8, 1803, it was "Resolved, that no aperture conveying the water into any water-closet heretofore constructed shall be larger than ¾ in., and that the water shall not be permitted to run into said closets for more than two hours in every 24 hours, and that only in the night, and no water from the said works shall be permitted to be discharged into any water-closet hereafter to be constructed."

Apparently, the water rates generally were based on apertures at this time, for at a meeting of stockholders held at the city hall Sept. 15, 1803, it was resolved that the rates previously established should be continued for three years for apertures exceeding ¾-in. diameter with $1 additional for each ¼ in. additional size. It was also resolved to charge $2 additional for water from any aperture into any water-closet heretofore connected—"it being the opinion of the stockholders that no water be taken for the use of any water-closet hereafter to be constructed."

A printed broadside pasted into the volume of minutes contains a resolution of the trustees dated Sept. 30, 1815. This was addressed to both stockholders in the company and subscribers for water, and appears to have had the double purpose of reassuring the former as to dividends and stimulating the latter to contribute to them, besides establishing a new schedule of rates. The document recites:

"That the Company was chartered on the 17th day of February 1802, with capital stock of $40,000, and a train of Wooden Conduits then laid from the Fountainhead into and throughout different parts of the City, which from the increasing expense necessary to keep the whole in repair Dividends to the stockholders have been irregular, and from the lowness of the rates totally inadequate to the advance."

Reference is made to a "General Meeting of the Stockholders," held Jan. 26, 1813, at which the trustees reported "that the wooden conduits were in many situations in a decayed state" . . . and that legislative authority had accordingly been secured for an increase in the capital stock of the company. With money so raised, a 6-in. cast-iron conduit had been laid to the reservoir at the head of Steuben St., "affording, without a wanton waste, an abundant supply, and from thence to every part of the city; and the highly essential object of furnishing this City with an ample supply of Water, remarkably soft and pure, and of a cold temperature, perpetuated in all probability for centuries to come, is now fully and completely effected." Because of this, the broadside declared, the stockholders have a right to look to the trustees "for a competent Dividend" and citizens for a supply of water for both domestic and fire purposes. To this end, rates from Nov. 1, 1815, were thereby established "which will, without the least hesitation, be punctually and cheerfully paid by every subscriber to the water who shall choose to continue taking it." These rates, in part, were as follows:

		Per Annum
1st Class dwelling houses,	Every 3 story double house	$16
2nd Class dwelling houses,	Every 3 story house with three windows in front on the lower floor, or two front rooms, with an L	14
3rd Class dwelling houses,	Every 3 story single house and 2 story double house	12
4th Class dwelling houses,	Every 2 story house with two front rooms and an L	10
5th Class dwelling houses,	Every 2 story single house (of two rooms on first floor) of brick, or fronted with brick	8
6th Class dwelling houses,	Every other dwelling house of whatever description	6
Every additional one family in any house, to $3 (or the house to be debarred water)		3
If more than one additional family in any house, each such additional family to pay		2
Every store, or store house, not otherwise rated		6

In addition, rates were given for various special purposes.

Interesting light on prices of cast-iron pipe and the lengths in which it was then offered is afforded by the minutes for May 1, 1813, when the trustees opened sealed bids for "cast-iron conduits," as follows:

1. From Thomas Trenor of Bennington, $128 per ton, of 3-ft. length.

2. Eliphalet Sturtevant, New York, $140 per ton of 3-ft. length or $120 for two-foot.

3. Holly & Hoffing, of Salisbury, Conn., $100 per ton "in joints of one length of 2 ft. each."

The contract was awarded the same day to the last named and lowest bidder, but with the proviso that the bidder supply 200 joints, "carefully cast, as a fair sample of the work, agreeably to a description laid down on paper by the superintendent and enclosed to them [the bidder] in order that a fair experiment may be made of the strength of the pipes according to the proposed dimensions, and that this Board will be ready to enter into a contract on the subject at any day when the parties will attend." Apparently the low bidder gave satisfaction, for on Oct. 4, 1813, the trustees resolved to contract with Holly & Hoffing for 150 to 170 tons additional of cast-iron conduit delivered on the dock in Hudson by Nov. 1, 1814, at $100 a ton.

Computation of the Coefficient of Discharge of Venturi Meters

Tests at University of Pennsylvania Indicate that Coefficients May Be Computed Within 0.5 Per Cent. of Experimental Values

By W. S. Pardoe
Assistant Professor of Civil Engineering, University of Pennsylvania, Philadelphia

FOR some time the writer has considered it possible to compute the coefficient of the centuri meter within 0.5% of experimental values, but has not, until a recent date, had sufficient data to check these computations. A large number of tests conducted by the writer in the hydraulic laboratory of the civil engineering department of the University of Pennsylvania on the Simplex meters ranging in diameters from 0.625 x 0.405 in. to 16 x 8 in., provided these data. Space does not permit of the publication of all these results, but the writer will give his method of computing the coefficients and some results, both experimental and computed, hoping that others may be led to publish experimental coefficients to check further the proposed formula.

Writing Bernoulli's theorem between points 1 and 2 (Fig. 1), the main and the throat, respectively,

$$e_1 + h_1 + \frac{v_1^2}{2g} = e_2 + h_2 + \frac{v_2^2}{2g} + hr_{1-2}$$

$$e_1 = e_2$$

$$h_1 + \frac{v_1^2}{2g} = h_2 + \frac{v_2^2}{2g} + hr_{1-2}$$

Express hr_{1-2} the resistance loss in terms of v_2 then

$$h_{r_1} = f_1 \frac{l_1}{d_1} \frac{v_1^2}{2g} = f_1 \frac{l_1}{d_1} \left(\frac{d_2}{d_1}\right)^4 \frac{v_2^2}{2g} \quad \text{as } v_1 d_1^2 = v_2 d_2^2$$

The formula for the loss of head in the conical section (h_c) may be computed by means of the calculus, as follows

$$dh_c = f \frac{dx}{d} \frac{v^2}{2g} = f \frac{dx}{d} \left(\frac{d_2}{d}\right)^4 \frac{v_2^2}{2g}$$

$$= f \frac{v_2^2}{2g} \frac{m^5}{d_2} \frac{dx}{x^5} \quad \text{as } \frac{d}{x} = \frac{d_2}{m} \text{ or } d = x\frac{d_2}{m}$$

$$\therefore h_c = k \int_m^{m+l} \frac{dx}{x^5} = -\frac{k}{4}\left[\frac{1}{x^4}\right]_m^{m+l}$$

$$= f \frac{m^5}{4\,d_2}\left[\frac{1}{m^4} - \frac{1}{(m+l)^4}\right] \frac{v_2^2}{2g}$$

Select f for mean values of velocities and diameters

$$\text{also } h_{r_2} = f_2 \frac{l_2}{d_2} \frac{v_2^2}{2g}$$

Substituting these values for hr_{1-2} in Bernoulli's theorem

$$\frac{v_2^2}{2g}\left[1 - \left(\frac{d_2}{d_1}\right)^4 + f_1 \frac{l_1}{d_1}\left(\frac{d_2}{d_1}\right)^4 + f \frac{m^5}{4 d_2}\left[\frac{1}{m^4} - \frac{1}{(m+l)^4}\right] + f_2 \frac{l_2}{d_2}\right] = h_1 - h_2$$

The loss of head in a straight pipe is due to skin friction, the movement of one filament of water over another and to impact between moving particles.

The loss of head in a conical pipe will be due to all of the foregoing causes, but the effect of the latter two will be much increased by the shape of the pipe. The writer has assumed that this condition extends down stream to the throat connection and that no serious error will be introduced by assuming it extends from the main to the throat connection.

To determine the relation between the actual coefficient of loss (C_{ra}) and the computed coefficient of loss (C_{rc}), a large number of tests were made on various sizes of venturi meters, and on a large conical brass nozzle. The results of these tests and computed coefficients of loss, plotted on logarithmic paper, gave the following relation

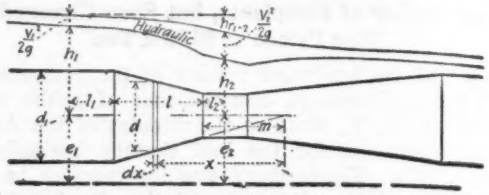


FIG. 1. SKETCH ILLUSTRATING DERIVATION OF FORMULA [Diameter of throat (not shown) = d_2]

$$C_{ra} = 5.75\ C_{rc}^{1.26}$$

solving the foregoing expression for v_2

$$v_2 = \sqrt{2g(h_1 - h_2)} \Big/ \sqrt{1 - \left(\frac{d_2}{d_1}\right)^4 + 5.75\left[f_1 \frac{l_1}{d_1}\left(\frac{d_2}{d_1}\right)^4 + f\frac{m^5}{4\,d_2}\left(\frac{1}{m^4} - \frac{1}{(m+l)^4}\right) + f_2 \frac{l_2}{d_2}\right]^{1.26}}$$

$$\text{also } v_2 = C\sqrt{\frac{2g(h_1 - h_2)}{1 - \left(\frac{d_2}{d_1}\right)^4}} \text{ as ordinarily used.}$$

Equating these values for v_2 and solving for C.

$$\therefore C = \frac{\sqrt{1 - \left(\frac{d_2}{d_1}\right)^4}}{\sqrt{1 - \left(\frac{d_2}{d_1}\right)^4 + 5.75\left[f_1 \frac{l_1}{d_1}\left(\frac{d_2}{d_1}\right)^4 + f\frac{m^5}{4\,d_2}\left[\frac{1}{m^4} - \frac{1}{(m+l)^4}\right] + f_2 \frac{l_2}{d_2}\right]^{1.26}}}$$

The dimensions of 3.971 x 2.00-in. venturi meter tested are:

$d_1 = 3.971$ in. $= 0.331$ ft. $d_2 = 2.0$ in. $= 0.1667$ ft.
$l_1 = 0.125$ ft. $l = 0.42$ ft. $l_2 = 0.085$ ft.

computations

$$\left[1 - \left(\frac{d_2}{d_1}\right)^4\right] = 0.9354$$

$$C_{r_1} = f_1 \frac{l_1}{d_1}\left(\frac{d_2}{d_1}\right)^4 = 0.0242\, f_1$$

$$C_r = f\frac{m^5}{4\,d_2}\left[\frac{1}{m^4} - \frac{1}{(m+l)^4}\right] = 0.668\, f$$

$$C_{r_2} = f_2 \frac{l_2}{d_2} = 0.51\, f_2$$

Values of f_1, f, and f_2 are taken from Fig. 2, which was plotted from Hamilton Smith's "Hydraulics," but has not, to the knowledge of the writer, been previously published in this most convenient form.

The values of C as computed in Table I are plotted in Fig. 3. The values of C obtained by actual test are plotted in Fig. 4. The discharge was obtained by the use of large weighing tanks and a split-second stopwatch. A very precise oil differential hook-gage was used for measuring low values of $h_1 - h_2$ and an air and a mercury differential gage for higher values.

The writer is well aware of published data of coefficients which show a decrease in C as the throat

TABLE I.

V_2	1	2	4	6	8	10	12	16	20	24
$Cr_1 = .0242\, f_1$	0.0011	0.00097	0.00087	0.00079	0.00074	0.00068	0.00065	0.00061	0.00058	0.00056
$Cr' = .668\, f$	0.0268	0.0228	0.0194	0.0176	0.0165	0.0158	0.0153	0.0146	0.0146	0.0145
$Cr_2 = .51\, f_2$	0.0255	0.0162	0.0137	0.0125	0.0122	0.0116	0.0114	0.0112	0.0111	0.0110
Total Cr_c	0.0534	0.03997	0.03397	0.03089	0.02944	0.02808	0.02735	0.02641	0.02628	0.02606
$C_a = 5.75\, Cr_c^{1.26}$	0.1450	0.1005	0.0820	0.0728	0.0684	0.0642	0.0622	0.0596	0.0591	0.0585
$\left[1-\left(\frac{d_2}{d_1}\right)^4\right]$	0.9354	0.9354	0.9354	0.9354	0.9354	0.9354	0.9354	0.9354	0.9354	0.9354
$C = \sqrt{\frac{0.9354}{0.9354 + Cr_a}}$	0.930	0.950	0.958	0.963	0.965	0.967	0.968	0.969	0.970	0.970

velocities increase, or the direct opposite of the variation shown in Fig. 4. Tests of at least twenty meters of various size, under the most favorable conditions, have failed to show curves differing in form from Fig. 4 also, it is well established that the friction factors (f) decrease as the velocity in a pipe increases. From the expression for C it is evident that if the velocity increases f_1, f, and f_2 will decrease and C will increase.

Table II and Fig. 5 have been prepared to show the variations in the coefficient with the diameter and with ratios of diameters of the main and throat, for a throat velocity of 15 ft. per second.

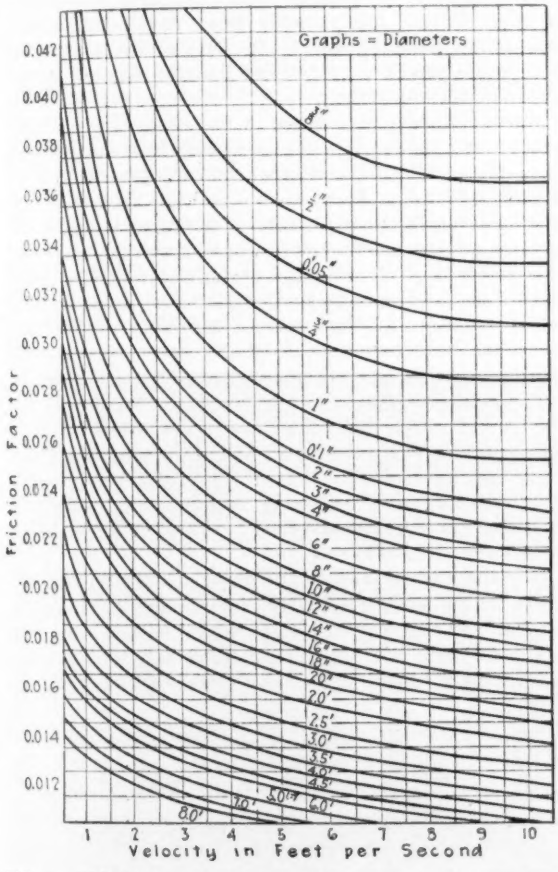


FIG. 2. FRICTION FACTORS FOR CLEAN CAST-IRON PIPE
Based on Hamilton Smith's "Hydraulics," $h = f\,(lv^2 \div d^2g)$

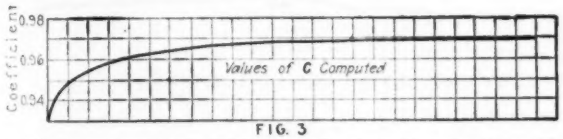


FIG. 3

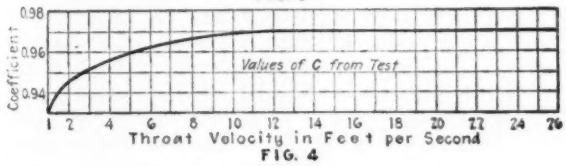


FIG. 4

FIGS. 3 AND 4. COMPUTED AND TEST VALUES OF C FOR 3.971 × 2-INCH METER

In Table II the first seven meters are Simplex Standards. As the length of the cylindrical throat is equal to its diameter then $l_2 = \frac{d_2}{2}$ also $l_1 = 1$ ft. for meters of diameter above 4 in. The last three are special short meters which, along with meters Nos. 3 and 4, indicate that changes in the ratio of main to throat diameter do not materially affect the coefficients. A comparison of meters Nos. 5 and 9 shows an increase in the coefficient of the latter on account of the reduced ratio of $\frac{l_2}{d_2}$ and the consequent reduction in friction loss.

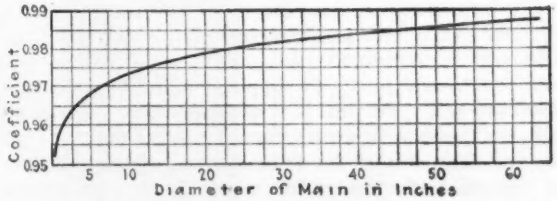


FIG. 5. VARIATIONS OF COEFFICIENT WITH DIAMETER OF MAIN
Throat velocity 15 feet per second; ratio of diameters, 2 to 1

TABLE II.

Number	1	2	3	4	5	6	7	8	9	10
Main d_1	60 in.	16 in.	8 in.	8 in.	6 in.	2 in.	0.628 in.	6 in.	6 in.	6 in.
Throat d_2	30 in.	8 in.	4 in.	2.667 in.	3 in.	1 in.	0.409 in.	4 in.	3 in.	2 in.
Ratio d_1/d_2	2/1	2/1	2/1	3/1	2/1	2/1	3/2	3/2	2/1	3/1
l_1	1.0 ft.	1.0 ft.	1.0 ft.	1.0 ft.	1.0 ft.	0.25 ft.	0.0052 ft.	0.2 ft.	0.2 ft.	0.2 ft.
l	6.75 ft.	1.8 ft.	0.9 ft.	1.2 ft.	0.674 ft.	0.225 ft.	0.0049 ft.	0.45 ft.	0.675 ft.	0.9 ft.
l_2	1.25	0.333	0.1667	0.111	0.125	0.0416	0.0017	0.0833	0.0625	0.0416
M	6.75	1.8	0.9	0.6	0.674	0.225	0.0092	0.9	0.675	0.45
Cr_1	0.000163	0.00093	0.00212	0.000503	0.00298	0.00247	0.00560	0.00166	0.00064	0.00014
Cr'	0.00760	0.01115	0.01275	0.01405	0.01310	0.0163	0.0201	0.01113	0.01390	0.01460
Cr_2	0.00525	0.00905	0.01000	0.01065	0.01065	0.01275	0.00913	0.00505	0.00530	0.00555
Total Cr_c	0.01301	0.02113	0.02487	0.02510	0.02673	0.03152	0.03483	0.01884	0.01984	0.02029
$C_a = 5.75\, Cr_c^{1.26}$	0.0245	0.0448	0.0552	0.0555	0.0603	0.0746	0.0846	0.0388	0.0415	0.0422
$\left[1-\left(\frac{d_2}{d_1}\right)^4\right]$	0.9375	0.9375	0.9375	0.98764	0.9375	0.9375	0.8197	0.8025	0.9375	0.98764
C	0.987	0.977	0.972	0.974	0.970	0.962	0.952	0.976	0.977	0.978
C from test		0.978	0.972	0.976	0.973	0.964	0.958			

The writer believes that the most important constructional feature of venturi meters is a perfect brass or noncorrosive throat-piece with proper piezometer connections, and a constant ratio of l_2/d_2, preferably $\frac{1}{2}$.

Fig. 6 shows a series of computed coefficient curves

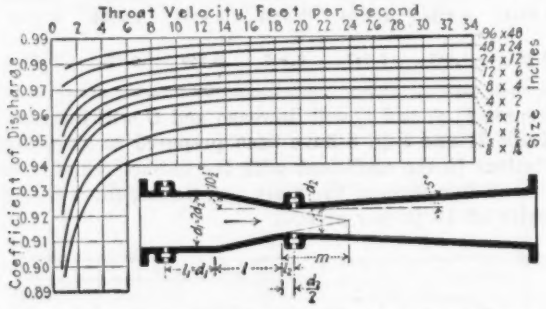


FIG. 6. VENTURI METER DISCHARGE COEFFICIENT

From formula

$$Q = \frac{C}{\sqrt{1 - \left(\frac{d_2}{d_1}\right)^4}} \sqrt{2gh}$$

$$C = \frac{\sqrt{1 - \left(\frac{d_2}{d_1}\right)^4}}{\sqrt{1 - \left(\frac{d_2}{d_1}\right)^4 + 5.75 \left[f_1 \frac{l}{d_1}\left(\frac{d_2}{d_1}\right)^4 + f \frac{m^2}{4 d_2}\left\{\frac{1}{m^4} - \frac{1}{(m+l)^4}\right\} + f_2 \frac{l_2}{d_2}\right]^{1.26}}}$$

which the writer believes will be found to be correct within 0.5%, and probably less.

Extensive Improvements to Akron Water-Works

Owing to the rapid growth of Akron, Ohio, from a population of about 69,000 in 1910 to one estimated at over 175,000 at the present time, it has been necessary to begin extensive improvements to the water-works. This has been required notwithstanding the extensions made between 1911 and 1915, with F. A. Barbour and E. G. Bradbury as consulting engineers. The extensions consist of a storage reservoir, rapid sand filters, a pumping station and an 11-mile force main. *Engineering News-Record* is informed by G. Gale Dixon, chief engineer of the Bureau of Water-Works Improvement, that the city has just completed additions to the filter plant, increasing its capacity from 20,000,000 to 30,000,000 gal. daily; a 10,000,000-gal. turbo-centrifugal pump, to supplement the two existing 15,000,000-gal. vertical triple-expansion pumping engines; increase in boiler capacity from 600 to 1200 hp.; and high service for a residential district, including automatically controlled motor-driven centrifugal pumps and a 350,000-gal. elevated steel tank. Work is in progress to parallel the existing 36-in. steel force main with a 48-in. lock-bar steel pipe line. About two miles of this main will be laid in 1919, and it is expected to build the other nine miles in 1920 and 1921. In addition, provision is being made for high service in another residential district and plans are under way for similar improvements in a third district next year. Distribution main extensions are being made by contract at the rate of about 25 miles a year. About two-thirds of the street mileage and three-fourths of the houses within the city limits have water service.

Improvements during the past two years have been made at the rate of about $1,000,000 yearly, but this rate will have to be doubled. The submission of a $5,000,000 bond issue in November is considered.

Permanent Plants for Chloramine Installed at Denver

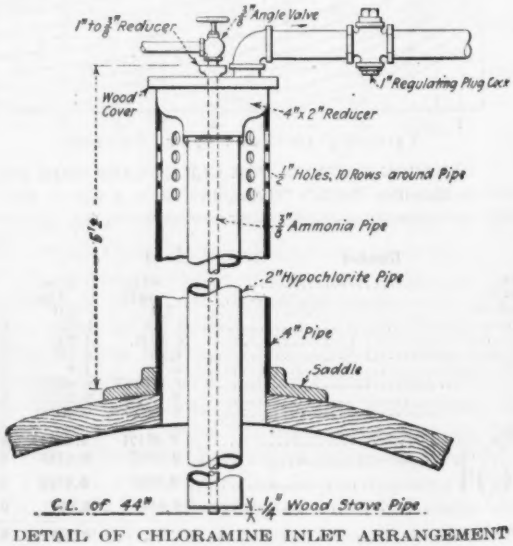
Simple Wood-Tank Outfit for Feeding Both Chemicals in Weak Solution—Ventilated Ammonia Tanks — Asphaltic Paint Used

SO SUCCESSFUL has been chloramine treatment of the water-supply of Denver, not only in holding down the immediate bacterial count, but also aftergrowths, that permanent plants have been installed at both outlets of Marston Lake. On the south side the hypochlorite and ammonia are applied to the effluent from rapid filters in service 26 years and now operated at double their rated capacity, a sand of 0.6 mm. being used to pass the water. The north-side plant consists of a rotary screening outfit described in *Engineering Record* of Sept. 4, 1915, p. 291. The original battery of four screens has recently been duplicated, and a chloramine plant similar to the one at the south side is in operation in a temporary location outside of the screen-house building.

Marston Lake has a range in turbidity varying from 0 to 35 and a bacterial content usually low, but varying from 250 to 1000. B. coli are generally present, but no chances are taken because of the high rate of filtration necessary and the absence of anything but 60-mesh screens on the north side. Algæ growths cause the greatest difficulty. Natural organisms and the treatment for their elimination, often, not always, have caused bacterial aftergrowths of enormous proportions. None has been experienced in the water treated with chloramine, although other supplies still show growths.

The plant consists of two hypochlorite-solution tanks, 5 ft. in diameter and 6¾ ft. high; two ammonia solution tanks, 4 ft. in diameter and 6¾ ft. high; a float-controlled constant-head barrel of 52-gal. capacity for each chemical, both delivering through plug cocks to a central point for introduction together into the 44-in. wood-stave effluent pipe.

For the ammonia side the chemical is stored as it comes in 800-lb. drums, a dose for making up a tankful of solution being forced into a section of 8-in. cast-iron pipe 5 ft. high, by the pumping of air into the ammonia drum with a Bishop & Babcock double-acting 3½ x 5-in.

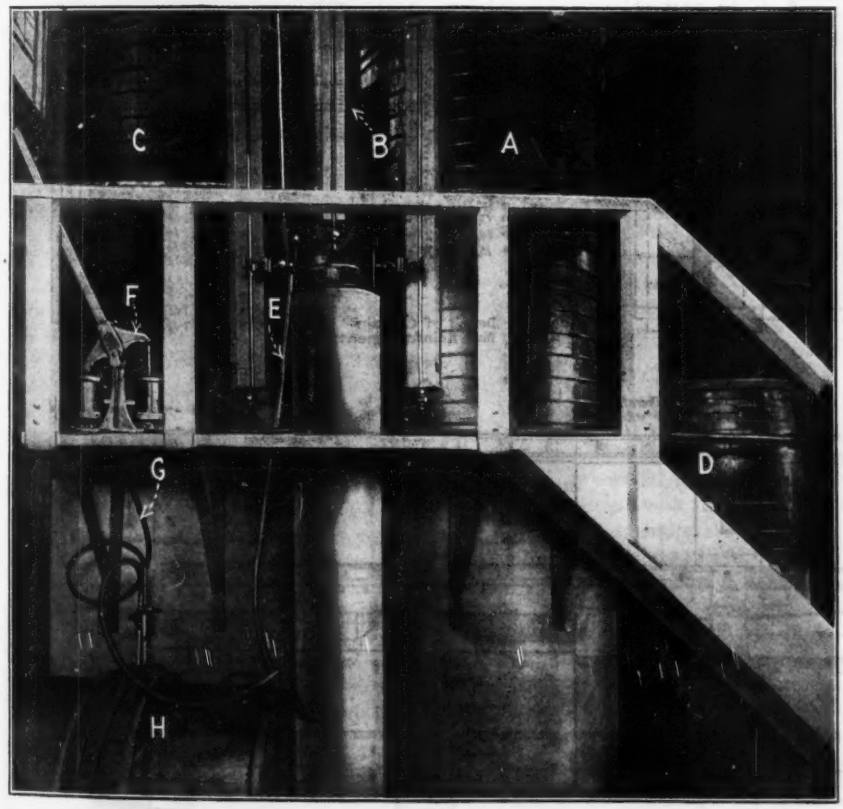


DETAIL OF CHLORAMINE INLET ARRANGEMENT

hand pump. All fittings for ammonia are of iron. A cast-iron line to the drain extends in a straight run directly under the center of the solution tanks and constant-head barrels. Crosses are used to permit cleansing with a boiler-flue cleanser. The gage on the small cast-iron tank reads in pounds of aqua ammonia, 29% anhydrous, and those on the solution tanks in pounds of available ammonia. Measurement is controlled by reading the drop in the solution tanks.

Of special importance is the arrangement for introducing the two chemicals simultaneously into the supply, experience having shown that unless this is done properly lime deposits occur, clogging the pipes. As finally worked out, a ⅜-in. pipe carrying ammonia extends down the center of a 2-in. hypochlorite pipe and ¼ in. beyond the end of the 2-in. pipe. Both pipes extend to the center of the 44-in. effluent pipe, being inclosed in a 4-in. pipe, the latter being attached by a saddle to the wood-stave effluent pipe and having 10 rows of ½-in. holes near the top for vent. Other features are the ventilating system, consisting of ¾-in. pipe from near the top of each ammonia tank, leading through the roof; also the coating of the wood tanks inside and out with ½ lb. of paraffin to 3 gal. of mineral pitch paint, applied hot. Wood covers sealed on with this paint retain all odors from the chemicals. All tanks rest on substantial, concrete foundation pedestals. Wood platforms give the operators easy access to valves and gages.

The design was made and the work installed last fall under the supervision of D. G. Thomas, former chief engineer of the Denver Union Water Co. C. L. Adams, superintendent of the Bear Creek division, has charge of the operation. By him and the principal filter operator, W. D. Jones, many of the details gained from experience with chloramine were suggested. Burton Lowther has been chief engineer and general superintendent since the plant was taken over by the city.



ARRANGEMENT OF AMMONIA ELEMENT OF CHLORAMINE PLANT

A. Solution tank; B, cast-iron measuring pipe; C, solution tank; D, constant-head barrel; E, ammonia tube; F, air pump; G, air tube; H, ammonia drum

Cement Joints for Cast-iron Water Mains at Shipbuilding Plant

By A. J. Newman
Engineer in Charge, San Pedro, Calif.

CEMENT joints for 6- and 8-in. cast-iron pipe are being used on automatic sprinkler and salt-water fire protection systems at San Pedro, Calif., by the Los Angeles Shipbuilding & Dry Dock Co. Up to July 29, 1919, a total of 3975 ft. of 6-in. and 6250 ft. of 8-in. pipe had been laid. Only three defective joints had to be cut out and remade. An average of 5% had a slight sweat which disappeared in a few hours.

Riverside portland cement is used with soft yarn entirely free from grease. The joints are spaced by using just enough yarn with which to keep the cement from going inside—the less cement the better. The yarn is soaked in liquid cement before using. Neat cement only is used. It should be rather dry, and the ideal condition will be found to be when it is moistened just sufficiently to ball when pressed with the hand. Hallet, from the Spring Valley Water Co., San Francisco, is foreman of pipe laying. This is tamped in solidly against the packing yarn by hand with a large calking iron. Calking with cement is continued until the bell is entirely filled and the calking iron will hardly make an impression on the cement and the bell rings. The joint is then wiped with a cement paste to a 45 deg. angle.

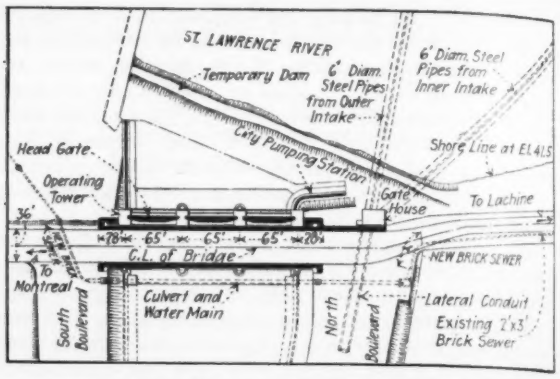
In making cement joints the pipe must be on a solid bed. If the trench has been made a trifle too deep, the pipe joints are blocked up on wood, so that they have a firm foundation. The trench is water-filled so that when the blocks rot, the dirt will become solid and the pipe well bedded. Tests are not made until 48 hours after the last joint has been calked. The trench is filled between joints. Each joint after being made is kept covered with pieces of wet sacks during the 48-hour period, after which a pressure of 180 lb. per sq. in. is kept on the line for two hours. About 600 ft. of pipe was tested at a time. T. J. Allan is superintendent of the plant. A. W. Hallet, from the Spring Valley Water Co., is foreman of pipe laying.

Headgates Combined With Bridge Over Aqueduct Canal

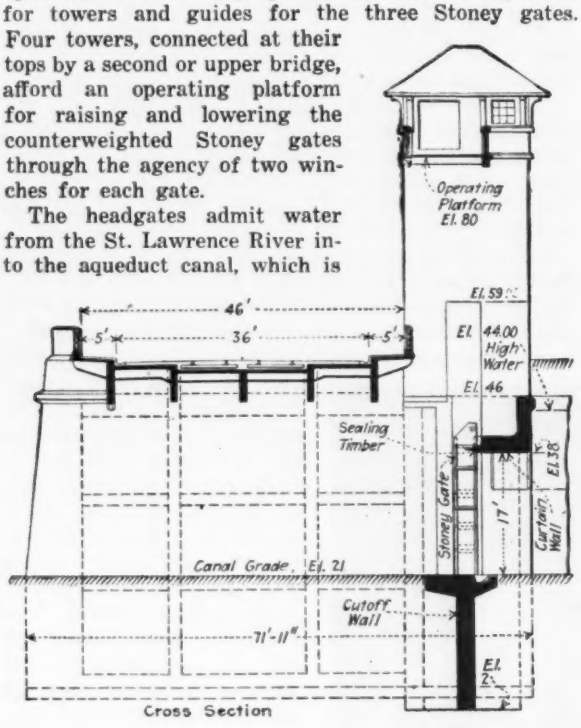
Heavy Reinforced-Concrete Structure in Three Spans With Stoney Gates Closing Waterways 57 Feet Wide and 17 Feet High

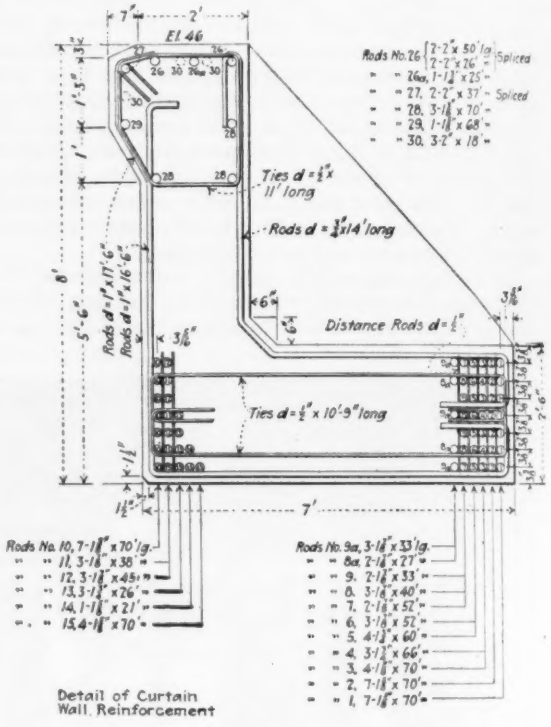
COMBINED in a single structure now well toward completion are the headgates for the Montreal aqueduct enlargement and the bridge carrying the Montreal-Lachine road over the new aqueduct or canal. With the exception of the Stoney gates, the structure is of reinforced concrete of the Hennebique system. Some of the reinforcement is heavy and intricate, especially that in the curtain wall. The bridge includes two sidewalks and a roadway, with provision for a future double line of street-railway tracks. Projections upstream of the bridge piers and abutments provide for towers and guides for the three Stoney gates. Four towers, connected at their tops by a second or upper bridge, afford an operating platform for raising and lowering the counterweighted Stoney gates through the agency of two winches for each gate.

The headgates admit water from the St. Lawrence River into the aqueduct canal, which is

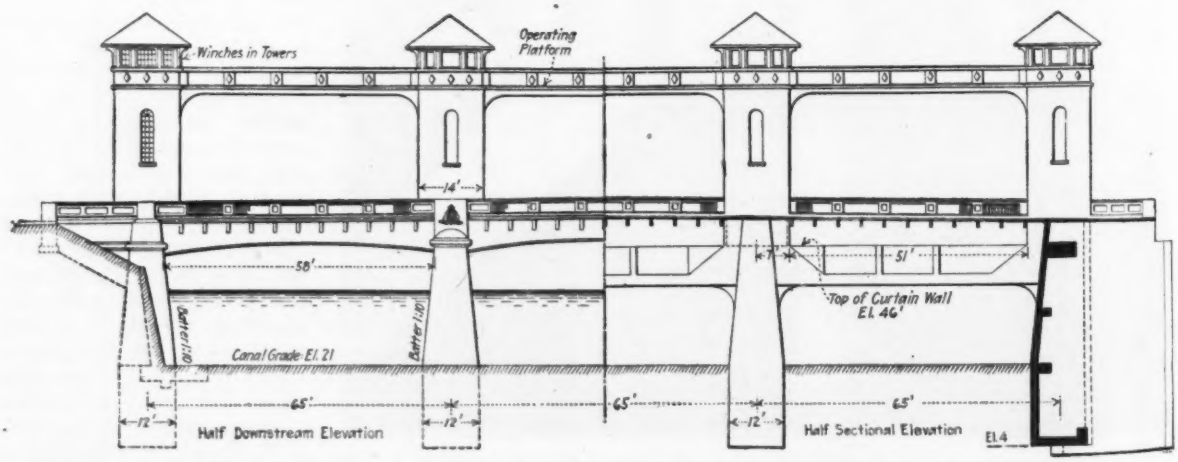


GENERAL LAYOUT OF BRIDGE AND HEADGATES

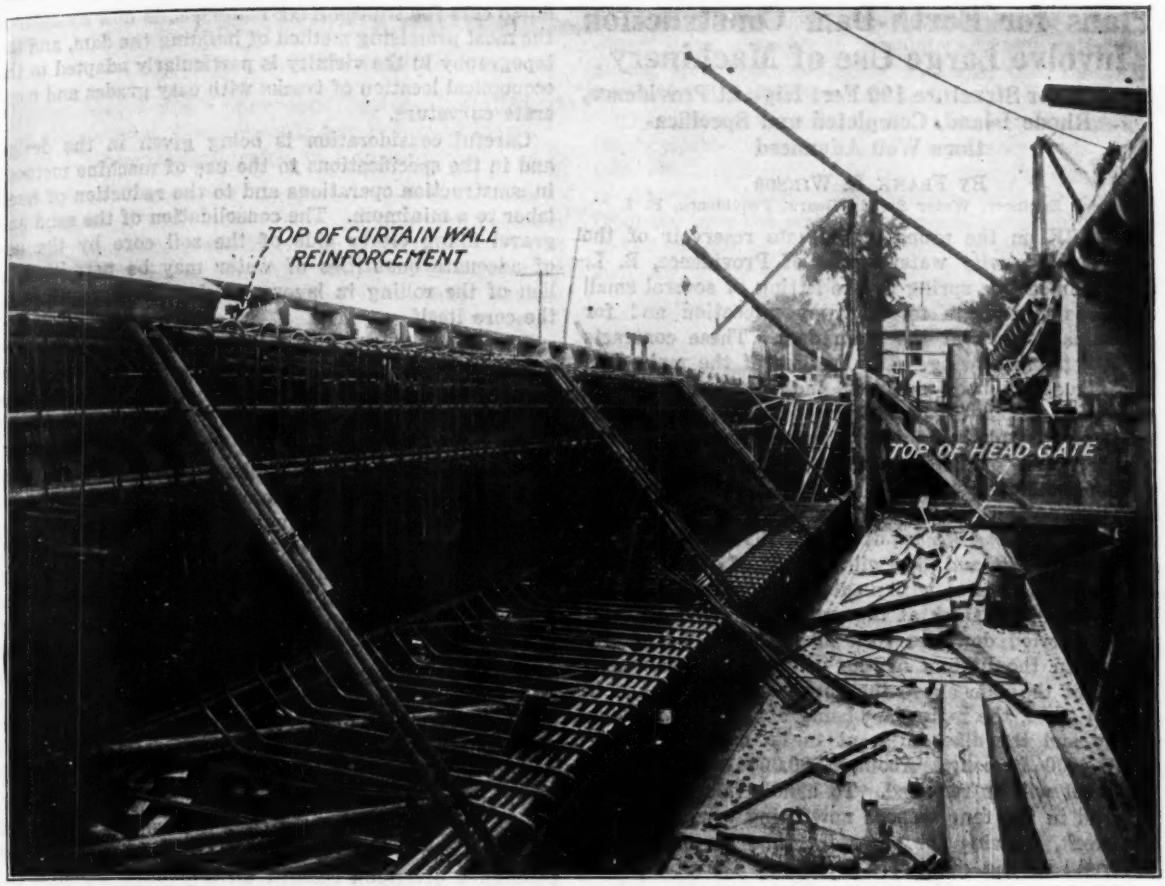




Detail of Curtain Wall Reinforcement



LONGITUDINAL SECTION OF COMBINED BRIDGE AND STONEY HEADGATES; ABOVE, CROSS-SECTION OF STRUCTURE AND DETAIL OF CURTAIN WALL



VIEW SHOWING THE REINFORCEMENT OF THE CURTAIN WALL

designed for water-supply and power. The canal at this point is about 185 ft. wide.

The three bridge piers are 65 ft. on centers. The gates are 58½ ft. long and 18 ft. high, and give a clear waterway 57 ft. wide and 17 ft. high. The maximum head of water is 23 ft. and the average about 16 feet.

The piers and the cutoff wall are carried to bedrock, from which point to the top of the towers is about 90 feet.

The curtain wall and Stoney gates have been so designed as to prevent obstruction of the river view from the bridge by the gates when lifted. Without the curtain wall the height and lift of the gates would be increased by 8 ft. When the gate is shut a sealing timber rests on a steel plate which projects from the bottom of the curtain wall.

Each gate weighs about 60 tons and is nearly balanced by counterweights. For the present the gates will be operated by hand, but provision has been made for the possible future installation of motors.

In the combined structure, not including wing walls, there are about 6000 cu.yd. of concrete and 400 tons of steel reinforcement. In the curtain wall there are about 230 cu.yd. of concrete and 80 tons of steel, or 670 lb. per yard of concrete.

The reinforced-concrete work was designed by L. G. Mouchel & Partners, Toronto, Ont., Canadian representatives for the Hennebique system. The designs for the Stoney gates were made by the Dominion Bridge Co., Montreal, which subsequently received the contract for making and placing the gates. The original contractors for the remainder of the work having relinquished their contract, the work is now being completed by Fraser Brace & Co., Montreal, on a cost-plus-a-fixed-fee basis. A. E. Doucet is director of public works of Montreal. T. W. Lesage is engineer-superintendent of the Montreal water-works. Frederick E. Field, the assistant superintendent of water-works, is engineer for the city.

Meters Prevented Water Famine at Pocatello

Except for a metering program entered into by Pocatello, Idaho, three years ago, the summer of 1919 would have seen the city practically without water. At present this town of 18,000 persons has 2100 of 4000 consumers metered, and the consumption has been cut from 350 gal. per capita daily to 110 gal. The supply is a mountain stream, with the low-water flow a constant after it dropped to about the 2,000,000-gal. consumption of the city. Restrictions on sprinkling to one hour per day per 30-ft. lot had to be strictly enforced, but the lawns came through in good shape, people learning that much less water than the usual drenching served the purpose as well or better. The drought which was broken Sept. 1 had lasted nearly five months. An investigation for a well supply is under way, but E. S. Anderson, consulting engineer, states that water from a spring five miles below the city or irrigation ditch water, filtered, is more feasible.

Plans for Earth-Dam Construction Involve Large Use of Machinery

Designs for Structure 100 Feet High at Providence, Rhode Island, Completed and Specifications Well Advanced

By Frank E. Winsor
Chief Engineer, Water Supply Board, Providence, R. I.

WORK on the proposed Scituate reservoir of the new gravity water-supply of Providence, R. I., was resumed this spring by the letting of several small one-season contracts for highway relocation and for preliminary work at the main dam. These contracts are now in full swing. The designs of the main dam and dike have been adopted, and contract drawings and specifications are well advanced. The date of advertising for bids has not yet been decided upon, owing mainly to the persistence of unsatisfactory conditions in the labor and material markets. A general description of this project, by the writer, was given in *Engineering News-Record* of May 3, 1917, p. 233.

The main dam and dike will be built of earth, mainly local sand and gravel, with a cutoff or core of compacted soil about 80 ft. thick at the maximum, rolled in 6-in. layers, carried down to rock about 80 ft. below the surface in the bottom of the valley. The maximum height of the dam above the surface of the ground is about 100 ft., the main dam being about 3200 ft. long on top and the dike, adjacent to its east end, being about 4000 ft. long. About 2,500,000 cu.yd. of embankment will be required. To handle this amount of material in the four seasons now being considered for this work, allowing the necessary time for excavating and refilling the deep core trench at the start, will require a plant capable of delivering regularly not less than 8000 cu.yd. of embankment materials during a working day.

The core trench will be excavated as an open ditch with stable side slopes which will, it is believed, vary from 1 on 1 to 1 on 2, with bottom widths at the exposed rock surface from about 60 ft. in the lower portion of the gorge to 40 ft. in the upper portions near the ends of the dam. A concrete apron about 1 ft. in thickness and 30 ft. in width, with two cutoff walls about 2 ft. high near either edge, extending longitudinally the entire length of the cutoff trench, will be built on top of the rock. Holes will be drilled into the rock, at whatever depth may be deemed necessary, and the rock foundation thoroughly grouted. It is believed that it will not be necessary to excavate any considerable quantity of ledge rock for a foundation for the concrete apron above described.

The excavation in the cutoff trench involves about 500,000 cu.yd., practically all of which will be sand and gravel suitable for filling either side of the core, and the work will be so laid out that this material can be placed directly from the excavation into the finished embankment. Soil and subsoil for the impervious core, of which about 600,000 cu.yd. are required, will be obtained from cleared areas below the reservoir flow line upstream from the dam and will involve a maximum haul of about three miles. Borrow areas for obtaining the bulk of the sand and gravel filling are located conveniently to the dam.

The use of the steam shovels, dragline scrapers, etc., for excavating, and long trains of narrow-gage power-dump cars for transporting materials, is now considered the most promising method of building the dam, and the topography in the vicinity is particularly adapted to the economical location of tracks with easy grades and moderate curvature.

Careful consideration is being given in the design and in the specifications to the use of machine methods in construction operations and to the reduction of hand labor to a minimum. The consolidation of the sand and gravel filling either side of the soil core by the use of adequate quantities of water may be permitted in lieu of the rolling in layers which will be required in the core itself.

The slopes of the dam will be protected on the upstream side by placing coarse materials on the lower portion and riprap on the upper portions exposed to the action of waves. The downstream side of the dam will be protected by soil dressing, draining and grassing.

The construction of the dike is similar to the construction of the dam, the details being dependent upon the depth of the water against the structure and the character of the material upon which it is founded. The gatehouse, foundations for which are already provided, is located over the stream-control conduit and will be provided with passages permitting regulation of the flow of water to the city and to the river below the dam. The spillway from the reservoir is located at the west end of the main dam and is a masonry structure nearly all founded upon rock, the rock foundation being prepared as in the case of the core trench. After flowing over the spillway, the water is conducted into an open channel excavated in the rock, back to the river.

It is expected that at the time the work is advertised the diversion of the river will have been completed through a diversion conduit already built through the dam, and that a portion of the cutoff trench west of the diversion conduit will be so far finished as to permit the placing of material excavated from other portions of the cutoff trench directly in place in the finished embankment.

The new water-supply project is being carried on by the Water Supply Board, composed of B. Thomas Potter, chairman; William A. Schofield, Henry A. Grimwood, William P. Vaughn, John Kelso, Joseph H. Gainer and Walter F. Slade, with Samuel N. Grammont, secretary. The engineering work is under the direction of the writer, as chief engineer, with William W. Peabody, deputy chief engineer, in charge also of the dam and aqueduct division, Frank E. Waterman in charge of the reservoir division and Francis B. Marsh in charge of the designing division.

Enough Timber for 150 Years' Exploitation

According to figures recently compiled by the National Lumber Manufacturers' Association, there is in the United States enough standing timber, with the addition of the present growth of new timber at the annual rate of approximately 20,000,000,000 ft., to supply raw material to the lumber industry for at least 150 years. This information is given by the secretary-manager of the association, who says also that despite the fact that the excess of exports over imports may somewhat increase the annual drain, the total domestic consumption will not greatly exceed the current figure of approximately 33,000,000,000 ft. per year.

Metering Renders Additional Water-Supply Unnecessary

Master Meter and Consumers' Meters Installed at Middletown, Connecticut, Are Followed by a Material Reduction in Consumption

THE 1917 report of the Board of Water Commissioners of Middletown, Conn., summarizes the water consumption experience of that city in 1915, 1916 and 1917, within which time the water-works have been transformed from an unmetered to a fully metered system. The 1918 report gives figures for that year. The case is a particularly interesting one, since the installation of meters was accomplished within a very short time and the forecasts of the engineers were justified in every particular.

During the winter of 1913 Metcalf & Eddy, consulting engineers, Boston, were employed to advise the Middletown water commissioners on the needs and most suitable sources of additional water-supply. Their report, which was published in full in the water commissioners' report for 1913, stated in brief that the present supply should be adequate for many years, if properly conserved, and recommended against obtaining an additional supply, as it would be folly to supply additional water only to have it wasted.

There were no trustworthy statistics of water consumption, the supply being obtained by gravity from two sources, but estimates based on the rate of depletion of the reservoirs at times when there was no rain, indicated that in 1891 the per capita consumption was about 90 gal. daily, in 1908 it was 110, and in 1913 it was 133 gal. Substantially all the increase appeared to be due to waste. The manufacturing services were metered, and the manufacturing consumption was equivalent to approximately 25 gal. per capita daily. It was estimated that under the local conditions the consumption in excess of 90 gal. was certainly wasted.

The safe capacity of the sources of supply was estimated at 2,300,000 gal. per day. The 1913 consumption was approximately at the rate of 2,000,000 gal. per day, and the reservoirs had been very nearly exhausted several times in the preceding years. The engineers estimated, however, that with reasonable per capita consumption the present sources should be adequate at least until 1940. They recommended, accordingly, that control meters be installed on the main supply pipe and that the services be metered as rapidly as possible, and in the meantime that waste and leakage be eliminated by house-to-house inspection.

The water commissioners were convinced that the course recommended was the correct one for the city to pursue, and succeeded in obtaining an appropriation from the common council for the purchase of meters. They immediately bought a venturi meter for the principal supply pipe, and commenced the installation of meters on domestic services. The first meters were installed on the services where it was believed that waste was the greatest. To quote from the report: The commissioners "immediately brought upon themselves the severest criticism. They persevered in the work, however, although by so doing they incurred much odium and were roundly abused. But experience now shows that their course was fully justified. There has been an enormous reduction in the consumption, and the almost total absence of complaints about water bills, during the recent collection, indicates that the people are satisfied with the present system."

The delays in obtaining the venturi meter made it impracticable to obtain accurate measurements of the total consumption prior to commencing the installation of domestic meters. The average daily consumption from the time the venturi meter was installed decreased as the number of meters increased, as shown by the accompanying table:

AVERAGE DAILY CONSUMPTION IN MILLIONS OF GALLONS

	1916	1917	1918
January	.....	1.449	1.321
February	.....	1.535	1.624
March	.....	1.492	1.624
April	.....	1.414	1.349
May	.....	1.357	1.332
June	.....	1.226	1.331
July	1.614	1.143	1.355
August	1.676	1.475	1.253
September	1.619	1.240	1.226
October	1.688	1.230	1.243
November	1.602	1.195	1.258
December	1.556	1.335	1.249
Average		1.341	1.338

The water commissioners estimate that this decrease represents a reduction in the per capita consumption from 133 to 78 gal. per person daily. They say in their 1917 report:

> It was not the purpose of the meters to compel consumers to stint themselves in the use of water, but to compel the careless consumers to stop avoidable waste and leakage. The discovery and stoppage of hundreds of leaks by the consumers, in coöperation with the water department, has shown that the metering of the services has had the desired effect. . . . Statistics of the November collections from metered services within the city show that 18% of the consumers are paying more than on the flat-rate basis, 80% are paying less and 2% are paying the same as before.

Diaphragms Damp Water-Gage Fluctuations

Fluctuations of water in a glass gage showing the head over a weir in the flume leading to the Marston Lake filters of the Denver water-works are damped so that reading is easily made by interposing, in the line to the bottom of the glass tube, a short piece of 2½-in. pipe with flanges on either end, securing a thin sheet of rubber gasket. The rubber inlet and outlet tubes connect to metal tubes (old automobile tire tube valves) secured to the center of the rubber diaphragms. The whole device was made on the job. Previously the fluctuations varied 4 in. at high flows and so rapidly that it was impossible to read the scale within 1 in., which represented a daily rate of about 2,500,000 gal. There is a slight variation now, but it is slow, and the scale can be read to less than ½ in. and easily to a 200,000-gal. rate.

The rubber tubing that is used is of about ¼-in. inside diameter. The weir-box supply rises from a pipe line leading from the lake underground to a point above the filters, so as to give a gravity flow through them. At the high rates prevailing during the past summer, when more than twice the designed capacity was cared for, the pulsations and disturbances were particularly troublesome. The device was worked out by C. S. Adams, superintendent of the Bear Creek division, under the general supervision of Burton Lowther, chief engineer and general superintendent of the Denver Municipal Water-Works Commission.

New Features in Indiana's Concrete Road Specifications

Recent Draft Includes Some of the Latest Ideas in Highway Work—Materials and Methods Covered in Detail

A RICH concrete, the cylinder test for consistency, combined hand-roller and belt finish, canvas covering and 15-day ponding, and the use of free steel dowels at construction joints, are among the features of the new concrete-road specifications of the Indiana State Highway Commission. These specifications include both one- and two-course construction, with and without reinforcement, but the conditions determining the use of these alternative designs are not stated. The concrete slab is 18 ft. wide, with a thickness of 8 in. at the center and 6 in. at the sides.

Proportioning of Concrete

For one-course paving, either crushed stone or screened and washed gravel may be used as the coarse aggregate, ranging from ¼ in. up to a maximum size of 2 in. as determined with laboratory screens, with not more than 5% by weight passing a screen having ¼-in. circular holes. The stone must have a French coefficient of wear of 8 and a crushing strength of 16,000 lb. Sand for the fine aggregate must pass a ¼-in. screen, with not more than 28% and 10% by weight passing the No. 50 and No. 100 screens, respectively, and not more than 3% by weight removed by the elutriation test. A mix of 1 cement, 1½ fine aggregate and not more than three parts of coarse aggregate is specified, but it is required that the total aggregates shall not exceed 4½ parts and shall be in such proportions as the engineer may direct.

Stress is laid upon the cement proportion, with a penalty for skimping. The specified proportion is 1.91 barrels of cement per cubic yard of concrete in place. The engineer is to compare the calculated amount of cement as required by the plans and specifications with the amount actually used each day, this being determined by counting the number of sacks used. If the amount of cement used on any day is 2% less than that specified, the contractor must remove the concrete and rebuild this section of the work.

Concrete mixing is to be done in a batch machine specified to be "of the boom-and-bucket type," the time for each batch being not less than 1 min. after all the materials are in the drum, and, during that period, the drum must make not less than 14 or more than 20 revolutions. Measuring boxes, timing devices and a water measuring and discharging device are to be provided. Concrete is not to be mixed when the temperature is at or below 35° F. Both steel and wood forms are permitted, and must be cleaned and soaped or oiled before concrete is placed against them. For the consistency test, a cylinder 6 in. in diameter and 12 in. high is filled with concrete which is tamped until a film of mortar appears upon the surface. Upon raising the cylinder, the vertical settlement or "slump" of the concrete must not exceed 2 in. when a mechanical finisher is being used or 4 in. when the finishing is being done by other methods permitted in the specifications. This is similar to the test requirements of the Illinois specifications noted in *Engineering News-Record* of Apr. 10, 1919, p. 735.

For finishing the concrete, the surface is to be struck off or leveled with a steel templet weighing not less than 400 lb. for a length of 19 ft. This templet is to consist of an 8-in. channel, crowned to the required cross-section and reinforced by an I-beam, T-rail or angle, so as to give it sufficient strength to retain its shape. The concrete is to be rolled transversely with a hand roller having a long handle and operated from one side of the paving. This roller is to be of metal, 6 in. in diameter, 6 ft. long and weighing 100 lb. It must be passed over the entire width of the paving at each movement, and the rolling is to be continued until free water ceases to come to the surface. The rolling will be followed by a belt finish. The use of a finishing machine is permitted, but no instructions or requirements for this are included in the specifications.

A canvas covering suspended about 12 in. above the surface is to be spread over the concrete as soon as the finishing operations are completed. In addition to this the engineer may require that the surface of the concrete be sprinkled. When the concrete has "hardened sufficiently" this covering is to be removed and the sides of the paving banked with earth. The pavement is then to be covered with water to a depth of at least 2 in., and this ponding is to be maintained for 15 days.

Earth cover at least 1½ in. thick is permitted on grades over 2%, where the ponding is impracticable, the concrete being wetted thoroughly in advance and the material kept continually moist. This cover is to remain at least 18 days, and precautions must be taken to prevent foot traffic for at least three days. Other methods of curing may be permitted. After the concrete has been cleared and swept clean, three days must be allowed for final curing. In no case is traffic to be allowed upon the road until 21 days after the laying of the concrete, while in cold weather the road will be kept closed for such longer period as the engineer may require.

Free Steel Dowels Used at Construction Joints

Expansion joints are not specified, but a plain butt joint is to be made at the end of each day's work by the use of a heavy plank, having its top cut to the proper crown. Steel dowels across the joint are provided to prevent independent movement of the adjacent slabs. These are ¾-in. bars, 4 ft. long, spaced 4 in. on centers and placed 3 in. below the finished surface. They are cased in paper so as to prevent a bond between the steel and the concrete; apparently they are intended to be free for their entire length. Special care is demanded in the making of these transverse joints, in order that the concrete may be true and level on both sides.

Any unevenness amounting to ¼ in. above or below the true surface of the concrete, whether at joints or other parts, must be remedied. Depressions must not be filled with concrete unless the slab has been cut to insure a thickness of 4 in. of new material. Where such a patch would have an area of more than 2 sq.ft., the concrete must be cut through to the foundation, for the full width of the slab, and a new strip of concrete placed.

Where reinforcement is used in one-course construction, it is to consist of steel fabric weighing at least 40 lb. per square foot. This is to be in flat sheets of a length 4 in. less than the width of the paving, the sheets being so constructed as to retain their shape during

the necessary handling. The transverse laps are 12 in., and if sheets are allowed to be lapped parallel with the center line of the road the lap must be not less than 4 in. The reinforcement is placed 2 in. below the finished surface of the concrete.

For two-course concrete roads, the stone for the coarse aggregate of the top course is to range from ½ in to 1 in., with not more than 5% by weight of the minimum size. If screened and washed gravel is used, it must contain at least 25% of stone and pebbles. For the bottom course, a 1:6 mixture of cement and aggregates is specified, approximating a 1:2:4 mix and having not less than 1.57 barrels of cement per cubic yard. For the top course the proportions are 1:3½, approximating a mix of 1:1½:2, with not less than 2.1 barrels of cement per cubic yard. In all cases the proportioning of the aggregates is subject to the requirements of the engineer.

Concrete for the top course must be placed as soon as possible after the surface of the bottom course has been struck, this interval being not more than 30 min. Where the bottom course has not been covered within this time it must be taken up. When reinforcement is required, it will be similar to that for one-course paving, but will be laid upon the bottom course immediately after it has been shaped in readiness for the top course.

Grading and Contracts

When the subgrade has been shaped to the required cross-section, it is to be rolled with a three-wheel power-operated roller, weighing not less than 10 tons. Loose rock, boulders and soft or yielding material which will not compact readily when rolled must be removed to a depth of at least 6 in. and replaced with suitable material. Where the surface of an old roadbed conforms approximately to the subgrade, it must be scarified to a depth of 8 in., while if the old surface is of telford or other construction made with large stones, the projections must be broken off, and crushed stone added to obtain the required cross-section.

The shoulders must be made of suitable material (not specified more particularly) and rolled as above. Embankments are to be built in layers not more than 12 in. thick, each layer being compacted by a roller as specified for the subgrade. Material containing sand in such proportions as to prevent it from compacting readily when rolled dry is not to be used, except by special written permission.

Provision is made for agreements with contractors as to payment for extra work, and for cases where alterations in plans or construction affect the amount or cost of the work. For construction done on a force-account basis the contractor will be paid the current local wages for labor, teams and foremen, and the actual cost of materials, including freight rates, with an addition of 15% to both wages and costs. When power-operated machinery is used, rental will be paid on the basis of hours of work.

No bonus is provided for rapid progress, but the penalty for delay in completing work beyond the contract time ranges from $10 per day, for contracts up to $500, to $30 per day for contracts of $50,000 and over. Monthly payments of 80% of the estimates are provided. Continual inspection is implied, it being specified that work done or materials used without supervision or inspection by a representative of the state highway commission may be ordered removed and replaced at the contractor's expense.

In addition to concrete roads, the specifications cover vitrified-block and bituminous-concrete pavements, particulars of which will be noted in a separate article. The specifications were prepared under the direction of H. K. Bishop, chief engineer of the Indiana State Highway Commission.

Federal Railroad Operation and Betterments Policy

Deficit Would Not Have Occurred Under Railway War Board—Betterments Abandoned During Remainder of Federal Control

By a Railroad Executive

A—Policy During the War

THE policy of the United States Railroad Administration respecting additions and betterments, on taking over the railways during the early part of 1918, was one of almost unlimited expenditure in all directions for the purpose of expanding the transportation facilities to the greatest possible extent in the shortest possible time to meet the war emergencies.

The railway facilities had previous to Federal control been operated practically as a unit under the Railway War Board, and, it can be stated, were operated successfully by this board. It was not that the railway facilities were inadequate or that they were not efficiently operated that they were taken over by the Government, but it was because they were not used efficiently by the various Governmental departments and it was necessary to place them under Government control in order to control their use. If the Railway War Board had been given the same powers as were given to the Director General of Railroads, and the railways had been guaranteed the same standard return as provided for in the Federal-control act, there would have been no deficit in the operation of the railroads as there has been under Federal control, and the country would have saved millions of money and the operation would have been more efficient than under Government control.

The reasons for these things are plain to the railway man, and can be readily made plain to anyone who is familiar with the processes under Governmental operation.

If the railways had remained under the operation of the Railway War Board with the same powers as were granted the Director General, the following results would have been secured:

1. There would have been no disturbance in the organization of the railways. The corporations would have remained in charge of the operation of their respective properties, reporting to the War Board as a central, controlling body, but the details of operation would have remained in practical hands, thus saving the demoralization of the forces incident to the centralization of operation as has been done under Federal control. This, alone, has cost the railways large sums and reduced the operating efficiency.

2. Under the centralization of control in Washington, the former well settled policies respecting operation, which vary on different systems, were changed, and attempts were made to make uniform, on 260,000 miles

of line and in all parts of the country, methods which in many cases were impracticable and occasioned much disturbance and consequent expense. An instance is the attempt to establish a uniform practice regarding repairs and renewals to freight-car equipment, as though the railways were one system. With the many types of equipment in use in various parts of the country this was manifestly impossible, but cost much in the attempt to carry it out.

3. The unification of facilities and equipment has also had its economical limits, but in the early stages of Federal control it was attempted to extend this policy, and in some instances expensive changes were made which must be abandoned at the end of Federal control. While the common use of freight cars has been useful, it has a disadvantage in that cars which are usually used to handle grain in the grain territory are now in the East or Southeast and the cars belonging to those regions are in the grain territory and not in all cases suitable to handle grain.

The difficulty has been that there were too many commissions appointed to handle practical questions. These questions were decided by the departments located in Washington instead of permitting the practical men in the field the necessary authority to work out and decide such problems on the ground.

The corporations have heretofore been accused of operating the railways from Wall Street, but it can be said that the *practical operation* has always been left to the local officers instead of such control being centralized, as was the case under Federal control, at Washington.

4. The handling of railway labor was likewise centralized in Washington, and uniform schedules of wages and working conditions were put into effect governing all the roads under Federal control. The same wages, for example, were paid to the Mexican track laborer working on the roads just inside the border on the Rio Grande as was paid in Oregon or Maine. The conditions surrounding railway labor differ in various parts of the country, but this distinction was leveled to one uniform rate and basis over the country and over 260,000 miles of road.

The relation of the wages of one class of employees to another, which relation has been in effect on American railroads for 50 years, was destroyed, and this caused much dissatisfaction among various grades of employees. A minimum wage was established, which made it obligatory to pay such wage regardless of ability or competency of the employee. The retroactive pay, which in many cases was wholly unexpected, cost millions of dollars. If those questions had been left in the hands of qualified railway men in the various sections of the country, an adjustment more satisfactory and less expensive would have been made.

Wage increases were justified and should have been made, but they should have been made with due regard to the necessities of each case; in some cases more would have been granted than was given, but it would have been done with due regard to the relationship between the various classes of employees and the value of their services.

5. The additions and betterment work authorized during 1918 was largely done without the previous consent of the corporations. It is nevertheless a fact that all that was done as war emergency work would have been carried out as promptly—and, it is believed, more efficiently—if the roads had been operated under the Railway War Board and through it by the former organizations.

The corporations, before Federal control, did not stand in the way of any improvements needed for the emergency, and did not do so after Federal control, but were not consulted in many important matters when their valuable aid would have enhanced the results.

The dismissal of men long connected with railway properties, who, by their experience and ability, were absolutely necessary to successful operation did not tend to improve the situation as far as economical and efficient operation was concerned.

B—Policy Since Signing of Armistice

The policy of the Railroad Administration regarding expenditures for additions and betterments during 1918, up to the signing of the armistice, was to increase railway facilities wherever necessary to help win the war—a very commendable policy, except in the method of carrying it into effect, as already set forth. The policy, however, has been radically changed since the signing of the armistice, and the year 1919 finds a very small program for additions and betterments, and much of the work started in 1918, though not completed, has been stopped.

It is a curious fact that with all the expenditures made on the railways under Federal control, there is less transportation capacity now than at the beginning of that period. The policy now in effect, to curtail in every possible way the expenditures on additions and betterments during the remainder of Government operation, means that there will be still less of transportation facilities at the end of Federal control. This is a remarkable situation, from which the country must necessarily suffer. Moreover, as pointed out in an article in *Engineering News-Record* of Sept. 4, 1919, page 457, the regular maintenance program of the railways is not being carried out, so that the roads at the end of Federal control will not be in as good condition physically as when taken over by the Government.

The country needs increased transportation facilities to handle the business which will offer in the immediate future. The program of 1918, which was carried out only to the extent of about 40% (the total program calling for a $1,250,000,000 expenditure) should have been continued in 1919, and the maintenance program of the test period, at least, carried out, in order that the roads might have been returned "in as good condition and complete equipment as when taken over by the Government."

The public is of the belief, unfortunately, that because millions have been expended on the railroads and that there is a deficit of many millions, the roads are in better condition physically than when taken over by the administration. This is not the case, and in addition to the financial deficit already existing there will be a large deficit in physical condition that must be made good.

Los Angeles Building Permits Show Increase

Statistics from the Department of Buildings, Los Angeles, Calif., show the following increase in the number of building permits issued: In August of this year there were recorded 1074 permits, with a total valuation of $2,402,444; during the same month in 1918 the number of permits was only 569 and their value $763,579.

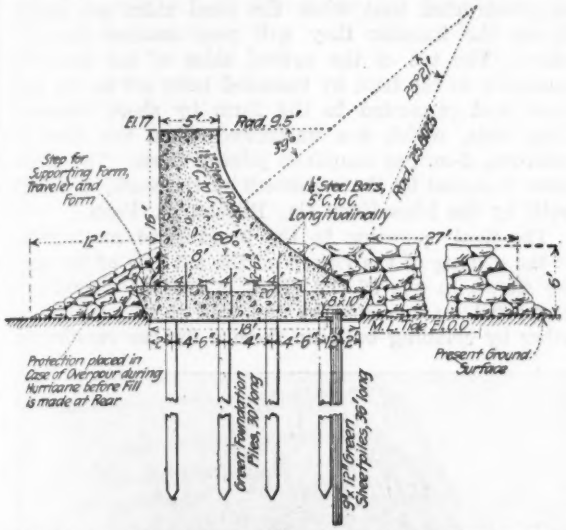
Extending The Galveston Sea Wall

Two-Mile Addition to Famous Concrete Protecting Wall Is Being Built With Maximum Use of Mechanical Aid

By J. B. Lippincott
Consulting Engineer, Los Angeles, Calif.

Galveston, as is well known, is protected against the waters of the Gulf of Mexico by a long, concrete sea wall built in 1903-4, after the hurricane of 1900 nearly destroyed the city. Under a recent appropriation of Congress and with additional money furnished by the county, there is now being built an addition to this wall nearly two miles long, the construction of which is distinguished by the very extensive use of machinery.

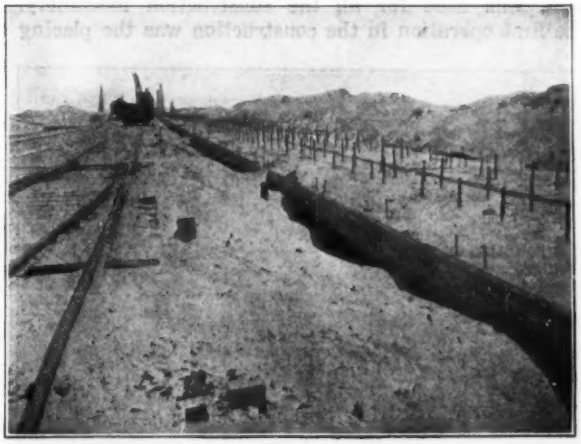
The original Galveston sea wall, designed by a board of engineers, appointed after the great storm of 1900 and composed of Gen. H. M. Robert, formerly chief



SECTION OF NEW GALVESTON SEA WALL NOW BEING BUILT A DISTANCE OF 10,300 FEET

of engineers of the United States Army, Alfred Noble and H. C. Ripley, was 3½ miles long (it was afterwards lengthened to nearly five miles) and of a section approximately the same as the new wall illustrated in this article. This section of solid concrete was founded on wood piling cut off about 1 ft. above low tide, with a base width of 16 ft. and a height of 16 ft., the top elevation being 17 ft. above low water. It was backed with a paved surface rising inland to a crest elevation of 19 ft., 100 ft. back from the face. The board recommended the raising of the street on the north or bay side of the island to 8 ft. and of the boulevard running longitudinally down the center of the island to 10 ft., but this filling was never carried out completely.

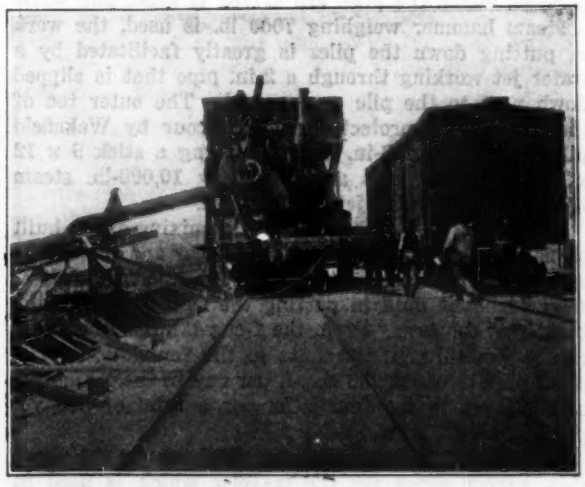
The original wall has now stood intact for about 15 years. The great flood of 1915 drove considerable water over its top, destroying in places the brick pavement that was laid on the sand, for a width of about 100 ft. from the shore side, and eroding some of the sand from the rear of the wall also. The wall did not fail; indeed, it saved the city from serious encroachment from the sea. Following this 1915 storm General Robert was again called into consultation by the city. It was then decided to make the slope rise inland from the top of the sea wall 4 ft. in 200, with a curtain wall at the new crest at an elevation of 21 ft. and with a depth of 5 ft. An intermediate curtain



COMPLETED FOUNDATION FOR NEW SEA WALL, WITH CONSTRUCTION TRACKS ON THE LEFT

wall of concrete sheet piles was driven 100 ft. back from the sea wall to a depth of 14 ft., and the space of 100 ft. back of the sea wall was paved with brick on edge in cement mortar.

The 1904 wall extended along the south side of the City of Galveston next to the gulf, and continued across a narrow neck of the island in a northerly direction across the east side of the city. From its easterly extremity the five-mile wall is now being extended a distance of 10,300 ft. The County of Galveston is to pay for 3300 ft. of this wall, and the United States for 7000 ft. To complete the protection to the Federal



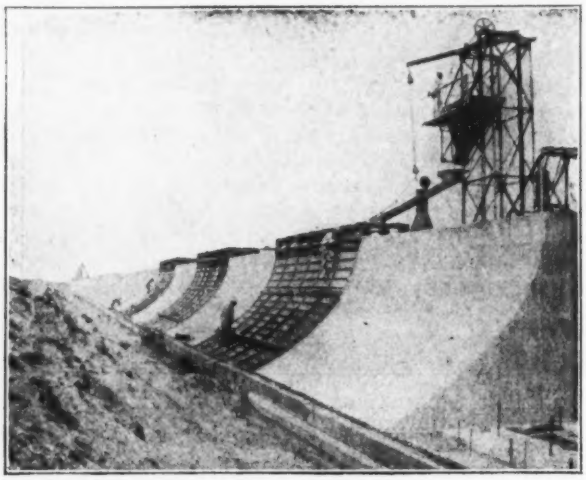
PLACING CONCRETE IN FOUNDATIONS FROM CONCRETING CAR—SUPPLY CAR ON RIGHT

fort at the extreme easterly end of the island will require 10,800 more ft. of wall.

The construction of the new wall is under the charge of the Corps of Engineers of the United States Army, and is being done by day labor. The design of the new wall, shown in the accompanying section, is approximately the same as the old wall, with some varia-

tions made necessary for special construction features.

Before construction was begun, a double-track railroad was extended along the rear of the new wall, with portable passing tracks farther in the rear. This track was used for all the construction machinery. The first operation in the construction was the placing



CONCRETING INTERMEDIATE SECTIONS OF THE NEW GALVESTON SEA WALL

of the pile footings. As shown in the views, piledrivers, traveling on the construction tracks, put down both foundation and protection piles; then followed the concrete mixers, making concrete for the footings, and, finally, the locomotive cranes and concrete mixers used in the construction of the main section of the wall.

Four round piles with 10-in. points and 30 ft. long are driven under the wall every 4 ft. The material through which the piles are driven is sand, and while a steam hammer weighing 7000 lb. is used, the work of putting down the piles is greatly facilitated by a water jet working through a 2-in. pipe that is slipped down next to the pile as required. The outer toe of the sea wall is protected against scour by Wakefield piling built up of 3-in. planks, making a stick 9 x 12 x 36 ft. These also are driven by 10,000-lb. steam hammers with water jets as required.

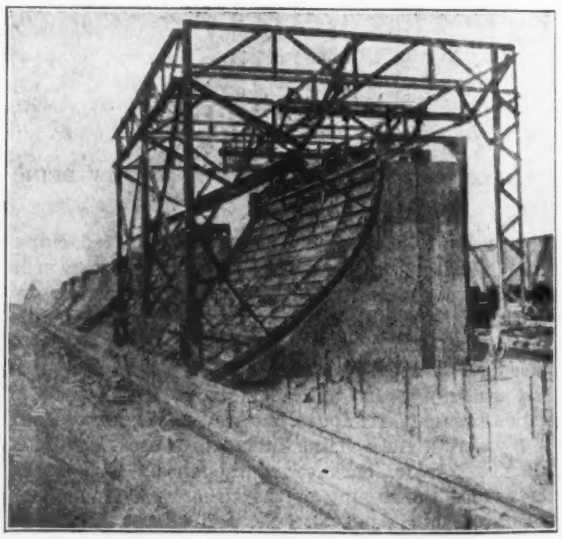
Concreting is carried on from a mixing plant built on flat-cars carrying the bins on one car and the engine and mixer on another. A locomotive crane with a clamshell bucket is used in putting the aggregate into the bins from the cars. From the 1-cu.yd. mixer the material is run through its chute to the foundation. The plant puts in about 260 cu.yd. per day in the main wall and 120 yd. in the foundation, or a total of 380 yd. per eight-hour day.

The footing is built with an overhang on the shore side, giving space for the traveler which is used in setting the forms for the superstructure. The foundation has a top width of 20 ft. and a bottom width of 18 ft. to provide the 2-ft. overhang noted. There is placed in the wall every 2 ft. a 1½-in. bar, 10 ft. long. This bar, set into the wall about 6 in., lies tangent to the curved surface of the wall on the side toward the sea and extends through the middle two-thirds thereof. The foundation is stepped to a 6-in. trough, as shown in a view, to prevent sliding of the wall.

When the foundation is completed, the next step is the erection of the steel forms for the main section of the wall. The forms are placed in alternate 30-ft. sections and are moved by an overhead traveler running on rails on the overhang described above. After alternate sections are completed the forms are moved back to concrete the sections left open. Details of the forms and the traveler are given in the accompanying drawing. The forms were designed to stand alone, after the traveler which places them has been removed. The main frame is of steel sections, with steel plate lagging and wooden-end bulkheads, the steel form itself being handled by the traveler and the wooden bulkheads swung into position by the locomotive crane.

It will be noted from the views and the drawings that the forms may be moved away from the concrete and suspended by turnbuckles on the traveler after the channel tying together the tops has been unbolted. These turnbuckles are attached to the forms by pins to permit of easy removal. The forms themselves are so constructed that when the steel sides are swung in on the traveler they will pass another form in place. The toe of the curved sides of the forms is anchored to the base by threaded bolts set in the concrete and connected to the form by short, threaded ¾-in. rods, which are unscrewed when the form is removed, 3-in. bar couplings joining them. The forms were designed by the engineers on the work, and were built by the Blaw-Knox Co., Pittsburgh, Penn.

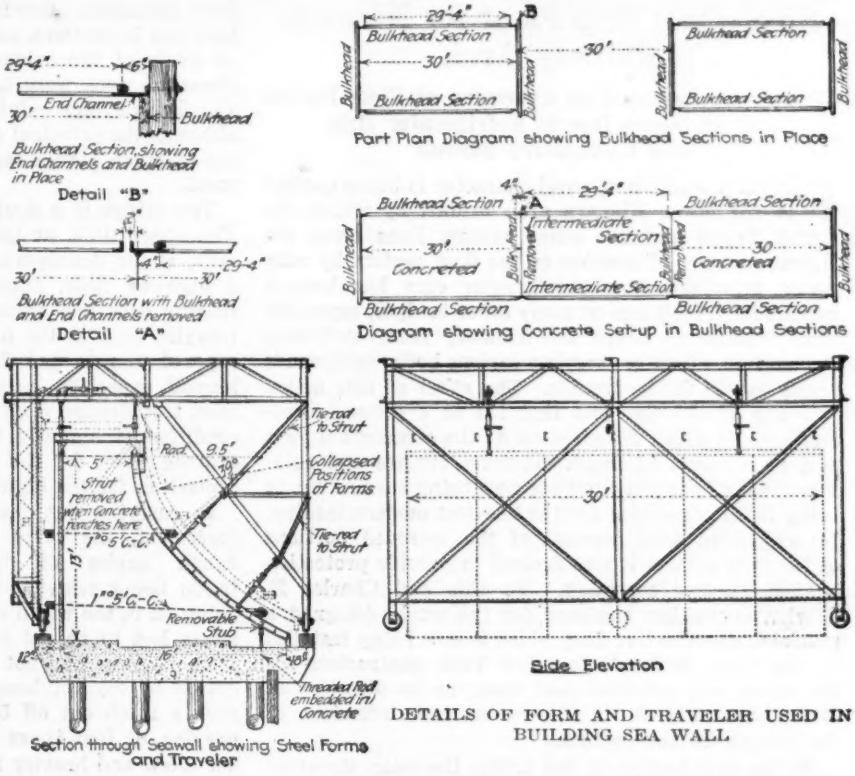
The final operation in the progressive construction is the placing of the riprap on the sea side of the wall. As shown in one of the views, a trussed platform is supported on one side by the wall itself and on the other by cribbing built up from a flat-car running on



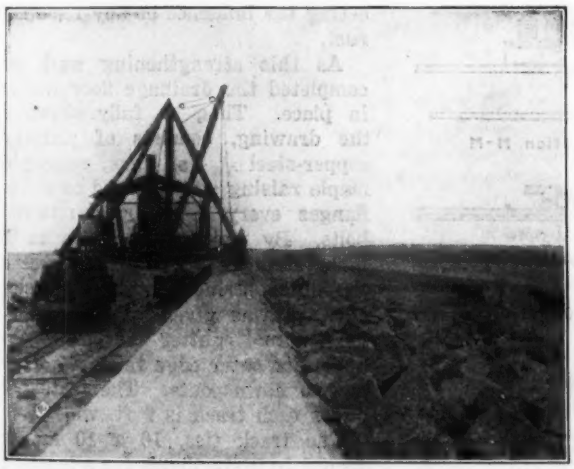
TRAVELER ABOUT TO MOVE STEEL FORMS

the construction track. On this improvised traveler is rigged a derrick which slings the riprap from flat-cars traveling on the other construction track over the wall to its final location in layers 21 ft. wide and 4 ft. thick next the wall and 4½ ft. on the outer side. This riprap is made up of 20% small stones ranging from 15 to 200 lb., 40% blocks from 200 to 1000 lb. and 40% in pieces of from 1000 lb. to five tons. It weighs about one ton per cubic foot as placed and costs $2.70 per ton delivered.

The base price for labor on the work is $3 for an eight-hour day, and the total number of men on the work, including those engaged in transportation, pile-driving, etc., is about 120. Concrete is used in proportions of 1:3:6, cement costing $2.07 per barrel delivered or $1.80 f.o.b. factory. Stone costs about $2.75 per ton delivered, sand about $1.75 per ton delivered. The lumber used was long-leaf yellow pine costing $42 per 1000 delivered. The wall contains 6.2 cu.yd. of concrete per lineal foot and the concrete is cost-in place, without distribution of equipment charge, about $9 per cubic yard. The sea wall built in 1904 cost about $100 per foot. At that time Mexicans were used for common labor at about $1.25 for a 10-hour day. As stated, the original Galveston sea wall is backed by sand fill, the top of which slopes toward the sea and is paved for a width of 100 ft. For the extension no arrangement has yet been made for backfilling or for pavement on the inner side, but the approved project calls for such work. The wall will be subject to severe blows from the rushing waves, and it is an interesting engineering problem whether this backfill should not be placed as a necessary part of the construction.



DETAILS OF FORM AND TRAVELER USED IN BUILDING SEA WALL



PLACING RIPRAP ON SEA WALL FROM TRAVELER ON OUTSIDE TRACK AND ON WALL

The work is under the direction of Col. Spencer Cosby, Corps of Engineers, U. S. A., the officer in charge of this portion of the coast, assisted by Col. P. S. Reinecke, U. S. A. The assistant engineer in charge of the work is John W. Henderson.

[Since the above article was written, Galveston, Sept. 14, 1919, was subjected to another tropical hurricane. As noted in the news pages of this issue, the old sea wall once more effectively served to stop the rising water, and, furthermore, the construction work on the new addition was not damaged. Apparently, the query put by the author as to the necessity for backfilling at the new wall was answered in the negative—for such service, at least, as was imposed by the latest storm—for there was no backing in place at the time the storm occurred.—EDITOR.]

Pay for Estimates, Say Contractors

In an effort to reduce their overhead costs general contractors, according to the September news letter of the Associated General Contractors of America, have been asking: If an owner is willing to pay for plans and specifications in order that he may see how his ideas work out on paper, why should he not also pay contractors for the benefit of their experience and efforts in determining what it would cost to transfer these ideas on paper into a concrete structure? Since "the owner reserves the right to reject any and all bids," contractors frequently submit bids where the work does not proceed, and where no remuneration is thus paid anyone for the expense of bidding. On the other hand, while it is true that the cost of estimating is a legitimate overhead expense, it is likewise true that modern business methods teach the segregation of general overhead expense as closely as possible and charge as many items as possible directly against the account where they belong.

Applied to the expense of estimating, this means, according to the contractors, that each job should bear its full share of such cost.

Steel-Plate Drip Floor for Niagara Railway Arch

Repairs Necessitated by Corrosion of Floor-Beams and Stringers Due to Refrigerator Drip and Locomotive Blowoff

FLOOR protection of novel character is being applied to the lower Niagara arch bridge, by which the Grand Trunk and five other railway lines cross the Niagara gorge. Corrosion of the floor system by salt-water drippings from refrigerator cars has become serious here, as it has on many other bridges, especially near terminals, where the blowoff, from switching locomotives, of water carrying various boiler compounds seems to add to the trouble. The effect of this action was one of the elements that led to a general overhauling and detail examination of the structure a year ago, as a result of which extensive repairs and reinforcement of the structure are now being carried out to bring it into condition for the heaviest modern loading. In connection with renewal of the corroded portions of the floor system it was desired to provide protection against further corrosion. To this end Charles E. Fowler, consulting engineer for the work, designed a special drip-protective floor which is now being installed by the Terry & Tench Co., New York, contractors for the repair and reinforcement work, under direction of Mr. Fowler and H. B. Dickinson, superintendent of the bridge for the owners.

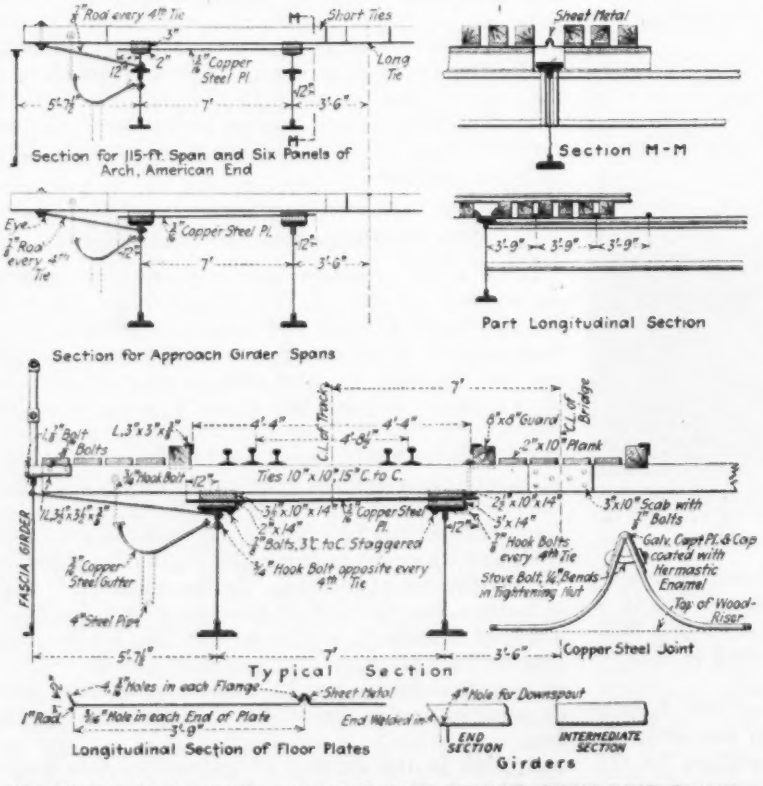
At the examination of the bridge the main structure was found to be in splendid condition, but the top flanges of floor-beams and stringers and the stringer laterals showed losses of 25 to over 50% in thickness from corrosion. Reinforcement of the weakened members was imperative, and as it was desired also to bring all parts of the bridge up to E 60 capacity the two pieces of work were taken in hand at the same time. The bridge was originally designed for about E37, although the principal members of the 550-ft. arch span are of much higher capacity and require no reinforcement.

The oridge is a double-deck structure 1080 ft. long. The upper deck, at the level of the top chord of the arch, is the double-track railway floor. Below this is a highway floor, framed between the trusses. The railway deck has always had a tie floor, with wooden troughs, so that the highway traffic was more or less exposed to rain and drip. Brine drip and locomotive blowoff, especially in case of standing trains, were the most troublesome feature of the situation so far as the condition of highway traffic was concerned. The new drainage floor for the railway deck was designed with protection for the highway deck as one of its objects.

In carrying out the floor-system repairs and reinforcement, the cover plates and in some cases the flange angles of the stringers were cut off, traffic being restricted to one track while work was going on in the width of the other track. About 65,000 rivets had to be cut out. Where injury to the metal from heating was not to be feared, rivet heads were cut off by oxyacetylene torches fitted with special tips; such a torch cut off 500 to 700 heads of $\frac{7}{8}$-in. rivets per day, or four times as many as one hand crew could do. New and heavier flange material was then riveted in place with countersunk rivets, so as to leave a flat surface as a seat for the drainage floor. All old metal was cleaned with sandblast and then painted with "Tockolith," with a view to counteracting the influence of any remaining rust.

As this strengthening work was completed the drainage floor was set in place. This, as fully shown by the drawing, consists of plates of copper-steel $\frac{3}{16}$ in. thick, resting on maple raising strips bolted to the top flanges every 3 ft. by countersunk bolts. By making the strips on the inner stringer thicker than those on the outer stringer a drainage slope outward was given to the plate; a longitudinal gutter of copper-steel under its outer edge takes the drainage to downspouts. The plate floor under each track is 9 ft. wide.

The track ties, 10 x 10 in., are dapped to 9½-in. depth for a length of 14 in., to receive 10 x 14-in. raiser blocks of hardwood in order to raise the ties clear of the drip plate. The thicknesses of the blocks over the inner and outer stringers differ by 1 in., as shown, so as to make up for the difference in thickness of the raising strips under the drip plate and thus bring the ties level. The blocks are spiked to the ties. All the timber is treated with hot carbolineum. The copper-steel floor plates are flanged sections 3 ft. 9 in.



NEW FLOOR OF NIAGARA RAILWAY ARCH BRIDGE, WITH DRIP PLATE AND GUTTER

wide, their length of 9 ft. extending crosswise of the track. The ends of the sheets are left plain. The side flanges, which form the joint between abutting sections, are 2 in. high, flaring, with fillet of 1-in. radius at the junction of flange and plate. Each flanged edge is punched with four $\frac{5}{16}$-in. holes; the two joining flanges are covered for protection by a channel of No. 16 galvanized sheet steel fastened by stove bolts, which also hold the adjoining sections together.

As the track structure rests on these plates without any bedding or through-bolting, attention had to be given to anchoring the track firmly. The ties are held down by hook bolts at the inner edge of the inner stringer only, the holes for these bolts through the drainage plate having no special significance because they are near the upper end of the slope of the plate. These bolts are spaced at every fourth tie, which is equivalent to one bolt per plate section. At the low side of the plate it was not considered advisable to have holes through the plate, on account of the opportunity this would give for the start of corrosion. However, every fourth tie was extended out to provide anchorage as well as to carry a footwalk; it is anchored back to the web of the outer stringer by a steel rod, either through the fascia girder or (on the approach spans) directly by a bolt attaching the rod to the tie. The inner ends of the long ties are fastened together at the middle of the deck by 3 x 10-in. scabs, three bolts in each tie.

Ties are spaced 4$\frac{3}{4}$ in. in the clear, to allow room for coating the drainage plate with enamel. Borden tie spacers are used throughout. The rail joints are of the bridge type, and, although the grade of the track is only 0.1%, the track is equipped with anti-creepers, partly because it is desired to maintain tight joints at the expansion points at each end of the structure, where 5 in. of expansion must be taken care of. Expansion joints of Quebec Bridge type are provided at these points.

In addition to the inner guard rails and outer guard timbers faced with steel angles, with which the deck was equipped, an outer guard rail has been added, as extra safeguard in derailment. This was done on account of the great height of the deck above the Whirlpool Rapids, 200 feet.

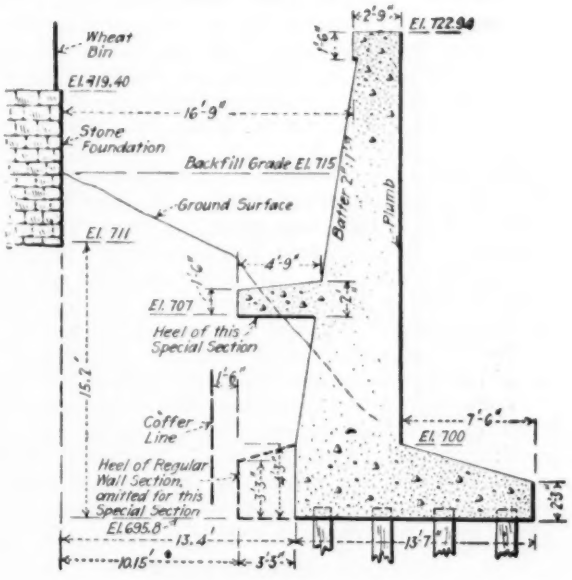
While some reliance was placed on the resistance to corrosion of copper steel as compared with ordinary steel, the whole upper surface of the drainage floor is painted with a special priming paint followed by a $\frac{3}{16}$-in. coat of "hermastic enamel," applied hot. The same coating is applied to the copper-steel gutter trough at the outer side of each drainage floor. The leaders from this trough are 4-in. steel pipes carried down clear of the bottom rib of the arch. With a view to facilitating recoating, the trough is attached by hooks so that it can be let down against the side of the stringer for cleaning and recoating. Similarly, the floor plates can be freed by slightly jacking up the track and (after removing the bolts which connect it to the adjoining plate) sliding a plate out like a drawer. When the plate is cleaned and recoated, it can be replaced in the same way. It is expected that the cost of recoating the portions of the floor subject to abrasion will be slight. The whole floor can be washed off with a hose, making it simple to clean it frequently.

Reinforcing the floor system of the bridge has been completed at a cost of about $30,000. The drainage floor or "salt-water floor" will cost about $25,000.

Unusual Concrete Retaining Wall Section Has Raised Heel

By R. C. Chaney
Construction Engineer, River Channel Improvement, Columbus, Ohio

LOCAL conditions dictated the use of a rather unusual type of reinforced-concrete cantilever retaining wall on a section of the Columbus, Ohio, flood protection work. As shown by a drawing, a circular bin containing 25,000 bu. of wheat was located within



RETAINING WALL WITH RAISED HEEL

17 ft. of the back of the wall, which was to be placed in excavation extending to 15.2 ft. below the foundation of the bin. It was considered unwise to continue the planned heel of the wall past the bin, as the excavation of a trench within less than 9 ft. of the bin might result in its collapse.

Accordingly, the heel was raised 11 ft. up the back of the wall, and placed on solid earth at that point, where it will act as the toe of the wall under high-water conditions and as the heel under low-water conditions.

This resulted in economy of excavation and was of advantage to the contractors, Hickey Bros., of St. Louis, Mo., in simplifying the construction problem. This particular piece of retaining wall was part of a levee wall which has a maximum height of 32 ft. and is 633 ft. long.

A Labor-Cost Increase of 540 Per Cent

In sewer work with 42-in. concrete pipe at Oklahoma City, Okla., during the present year, each section of pipe was rolled into position by nine men who were paid $4.50 per day, making a labor cost of $40.50 per day for handling pipe. On this same work in 1916 three men at $2.50 per day did the work, making the labor cost only $7.50 per day. These figures are given by the contractors, Bent Bros., Los Angeles, Calif. If the two groups did equal work the labor cost was increased 540% while the efficiency was reduced to 33% that of 1916.

Young Co. Classification of Dominion Employees Criticised

American Engineers Protest Against Low Salaries in Proposed Canadian Schedules, Fixed by Firm Retained to Classify Civil Service Here

ADVERSE criticism has been offered by individuals and organizations representing the engineering profession in the United States to the recommendations for the classification of employees in the Canadian civil service made by the accounting firm of Arthur Young & Co., of Chicago, Toronto and New York. Because this firm, which made the classification for the Dominion Government of Canada under authorization of the Canadian Parliament and under the supervision of the Civil Service Commission, has been retained to make a similar classification for the United States Congressional Joint Committee on Reclassification of Salaries, an analysis of the Canadian report is particularly pertinent.

Copies of the Canadian report have reached various individuals and engineering organizations, and numerous analyses of it have been made. A number of letters have been received from professional men by Engineering Council, and the chief objection to the recommendation made by Arthur Young & Co. is that compensations indicated or proposed are inadequate, particularly for higher grades of service. Of the analyses made of the Canadian report, perhaps the most studied is that offered by a member of the Federal Government Section of the Engineering Council Committee on Classification and Compensation of Engineers. Not only has this engineer singled out what he considers essential objections to the proposed classification, but in each case has suggested a remedy.

Four Criticisms Offered

The Canadian report is published in two parts. The first part, a volume of 82 pages, describes the principles and the methods underlying the classification, and the second, a volume of 678 pages, contains what is called the "classification." In general, and particularly as applied to conditions in the United States, the Canadian report is objected to on the following grounds:

1. Considered as a whole, it is only the first step in a real classification.

2. Unnecessary "classes" have been provided.

3. There is no apparent systematic basis for the salary schedules recommended, such schedules have been fixed by classes rather than by groups of comparable classes, and there is no necessity for the multiplicity of grades provided.

4. The fundamental principle on which salary schedules have been fixed is unsound in theory and unsatisfactory in practice, and the provisions for promotion in salary within the various classes are inadequate.

The Canadian report bases salaries, not upon living costs at the time the classification was made, but upon what would have been normal conditions for 1918 had the tendencies of the period prior to the war continued and had the war not occurred. Under the heading, "The Principles and Policies Adopted as a Basis for the Recommended Schedules of Compensation," in Part I of the Canadian classification, is the following:

"5. That the salaries proposed should not be based on the depreciated value of the dollar of the present time as measured by the abnormally high costs of the necessities of life that have developed as a result of the war. Conditions are now not stable. Economic conditions the world over are in an unsettled and uncertain state, and to found a salary revision on what may prove to be temporary conditions might involve the necessity of a downward revision when conditions return toward the normal. On the strength of these considerations it was decided to base the general level of the salary schedules on what would have been normal conditions for 1918 had the tendencies of the period prior to the war continued and had the war not occurred."

Under the same heading occurs the statement that "fairness to the employee requires that the compensation should permit him to maintain a standard of living such as to make for the good of society and posterity. In the case of the lowest ranks of service, the compensation should be adequate to attract into the service young men and women without family responsibilities but of a training and capacity that will enable them to become of future value to the service and to themselves." To determine what may be a living wage under present high costs, the following paragraph from the monthly Labor Review of January, 1919, which is an extract from a report submitted by the Bureau of Labor Statistics for the District of Columbia, is cited:

"In 1916 the typical white family, consisting of father, mother, and three children below the age of 15 years, was not able to make both ends meet with an income of less than $1150 per annum. This would indicate that a minimum-of-comfort budget, according to the practices and standards of domestic economy prevailing in Washington in 1916, must be about $1200. Since 1916 the cost of the necessities of decen living, weighed according to importance in the family budget, has advanced approximately 50%. This indicates that an identical standard of decency cannot be purchased for less than $1800 today."

Commenting upon this report, an engineer said:

"No data are available for comparing living costs in Canada and here. Presumably they are somewhat less there. However this may be, in the Canadian classification 700 classes and subclasses, or 35%, have a minimum salary rating of $1200 or less, and 500, or over 25%, have $1000 or less. Even if we assume that a reasonable living wage in Canada in 1916 was $1000, as compared with $1200 in the District of Columbia, the rise in price levels would make $1540 the living wage in Canada in these years. Of the 1970 classes and subclasses, nearly 1,100, or 56%, have a minimum salary rating of less than $1540 per year—that is, in 1918 and 1919 would not have paid a living wage to a family of five. While undoubtedly many of the lowest grades carry subsistence or other perquisites in addition to the salary, such a provision is not likely to affect many grades above $1000, or materially to change the proportion of classes which, all compensation included, receive less than $1540 per annum.

"Even if the opinion of the expert employed could be substantiated—namely, that the high scale of prices is only temporary and will soon return to the normal represented by the projected curve—it is apparent that the recommendations made propose to throw upon the employees themselves the entire burden during the

readjustment period of meeting the difference between the actual and the assumed purchasing power of a dollar, notwithstanding the fact that at the very time the recommendations were made the actual purchasing power was only 53 per cent of the assumed purchasing power upon which salary schedules were based.

"The opinion of the experts that the present price level is merely temporary is directly contrary to the considered judgment of such of our Government agencies as the Department of Labor and the Federal Reserve Board, and of such economic experts as Prof. Irving Fisher. All the evidence of past price history points to a permanently higher price level. There can be no sound or satisfactory basis of salary adjustment that does not take this evidence into account. The only basis, therefore, for salary adjustments which is fair to the employer and to the employee, is one based upon the varying index numbers of those commodities which enter into the cost of living. Base salaries for the various services and grades should be fixed on an index of 100. This having been done, each bureau or department in making up its annual budget estimate should determine its salary requirements by multiplying the base salaries by the index number of the preceding year, such number to be annually prepared and submitted by some standard authority, as the Bureau of Labor Statistics. It probably would not be advisable to change salaries for fractional variations in the index number, or by increments of less than $60 a year. The important consideration, however, is that such a scheme would provide for real rather than apparent salaries, and would be fair both to the Government and to the employee."

Objections to Proposed Classification

The first objection to the proposed classification is based on the fact that the various classes are not arranged according to the alphabetical position of the substantive part of the class designation, but by the alphabetical position of the first word in the name of the class, which is ordinarily a descriptive adjective. Thus, "chief engineer" would be found under "C"; "assistant engineer" would be found under "A"; "junior engineer" under "J"; etc. The classification contains approximately 1750 "classes" and 200 subclasses, arranged according to this order. There are 184 different "classes" of technical engineering positions, not including certain positions carrying the word "engineer" in the title, such as marine engineer, engineer (life-saving service), engineer master, etc. With this classification, it would be a work of months to determine the relation between corresponding classes in all the various vocations or groups of vocations. Classification is simpler if differentiation is made between classes of services instead of grades. It is simpler to determine whether a particular individual shall be classed as a "chemist" or as an "engineer," than to determine whether he should be classed as an "organic chemist" or a "structural engineer," and this in turn than to determine whether he should be classed as an "assistant organic chemist" or an "assistant structural engineer." Classification should proceed from the major division, downward, rather than from the minor division upward.

A revision of the classification which has been suggested would provide for a grouping of Government services in descriptive classes, such as scientific, professional, engineering, clerical, etc. Further divisions indicative of vocations, as civil engineering, mechanical engineering, electrical engineering, with a further division into grades differentiated by the amount of training and experience required and the degree of responsibility involved, are suggested. Finally, these divisions would contain provisions of approximately equal requirements, responsibilities and duties.

Unnecessary Classes Provided

As evidence that unnecessary classes are provided in the Canadian classification, the fact may be cited that out of 184 engineering classes listed there are 12 classes of junior engineers, as follows: Junior engineer, junior electrical engineer, junior electrical engineer (wireless), junior geodetic engineer, junior hydrographic engineer, junior hydrometric engineer, junior irrigation engineer, junior mechanical engineer, junior mechanical engineer (dredge design), junior power-development engineer, junior structural engineer and junior topographical engineer.

These are the lowest grade of positions carrying the designation of engineer, have a salary range of $1680 to $2040 per annum, with the exception of the topographic engineer, and require either a high-school education with four years' practical experience, or "graduation in engineering from a school of applied science" with two years' experience. Such positions would be filled by young men just entering upon their engineering profession, who are likely to have had a general engineering education and hardly likely to have had a character of experience justifying the extreme specialization for which these classes provide.

Differentiation between civil, mechanical and electrical engineering may be desirable, but further differentiation than this is hardly necessary.

The third objection, that is, that there is no apparent systematic basis for the salary schedules recommended, and that there is no necessity for the multiplicity of grades provided, is found in the fact that though through the greater part of the scale minimum limits vary by $60 a year, there are in many cases several different maxima for each minimum grade. As an example of this, there are 29 classes having the common minimum salary of $2700 a year, but with 11 different maxima. These maxima range from $2700 to $3600 annually. In the 184 engineering classes listed there are 77 salary grades actually prescribed.

Had the various classes been segregated, as has been suggested, into groups and services, it would have been a comparatively simple matter to have established grades containing all those classes within a given service in which requirements and duties were comparable and to have fixed salary limits to such grades, with results far different and far more satisfactory than were actually reached.

The range between the minimum and maximum limits, at least within the engineering service, is generally inadequate. Within reasonable time limits the value of the services of an individual in an organization increases in proportion to the experience in his position. This is particularly true of new employees. In order

to recompense this increase in value of service without the necessity of constantly moving individuals into new classes, the salary limits should be wider than prescribed in the Canadian classification. This matter also would be greatly simplified if salaries were fixed by few and well defined grades, rather than by a multitude of nonrelated classes.

As regards promotion within classes, the Canadian report contains the following:

"That an employee in a position of a given class may be advanced from the minimum salary to the next higher salary rate or from any intermediate salary rate to the next salary rate, provided he has served at his present rate for such period as may be specified for the class or all classes by the law or by the regulations of the Civil Service Commission, and provided that the advance is recommended by the deputy head and approved by the commission after the commission has satisfied itself by any method that it may deem adequate that the employee has attained and maintained a satisfactory standard of efficiency and has increased his usefulness to the service."

As to this provision, the following comment is quoted:

"If the services of an employee when appointed, or when advanced to a new class or grade are at that time worth the prescribed entrance salary, and if the employee is a person who should be retained at all, it is self-evident that his services are worth more after he has had experience in his new position than before he had the experience. A certain amount of promotion in salary, based upon the very fact of experience in the position held, should be automatically accorded to employees. To leave such matters solely to the discretion of the head of the organization means much inequality throughout the civil service."

It has been suggested that an efficiency rating system among civil-service employees similar to that used by the United States Army in rating its officers be adopted. Thus, in any body of employees, the rating would be more relative than positive.

After the employees in a single group have been rated relatively, the division of that group into three equal parts could be made. Provision could be made for all employees in the upper third to be automatically given the standard annual promotion of their grade, unless the right to receive it is for some good reason withheld by affirmative action of the appropriate authority. This scheme would grant to individuals in the middle third one-half of the standard annual promotion under similar conditions; and, finally, no promotion would be received by those in the lower third, except upon the affirmative action of the appropriate authority.

Arthur S. Tuttle, chairman of Engineering Council's Committee on Classification and Compensation of Engineers, in a recent letter to Secretary Flinn finds that the Canadian report "is open to serious criticism on the ground that it fails to group engineering service along orderly lines, that it provides too narrow limits for promotions within a grade, and that the compensation proposed for all grades is inadequate for the service rendered."

"The report," continues Mr. Tuttle, "appears to cover every position in the civil service. It is arranged alphabetically and, in the absence of grouping, a complete analysis of the engineering service involves a task of magnitude greater than I have found time for. I have attempted, however, to make such examination as time permitted and am impressed with a belief that the objections raised are well found. No attempt seems to have been made to standardize titles. Consequently there are in the engineering service at least 157 independent titles as compared with the 13 titles proposed by our committee. It is recognized that qualification of a general title to show the nature of the service rendered is quite proper, but in the judgment of the writer there is no reason for treating similar positions as entirely unrelated and as warranting entirely independent specifications.

"The report states that the compensation proposed are intended for 'normal times' and that, pending restoration of such time, the rates recommended should be 'supplemented by a bonus,' but no information appears as to the magnitude of the bonus.

"From my study of the report it would appear that the groups and ranges of compensation, tabulated as far as practicable under the classification tentatively proposed by Engineering Council's Committee, are about as indicated in the accompanying table."

TABULATION OF TITLES AND SALARIES FOR ENGINEERS IN CANADIAN CIVIL SERVICE REPORT UNDER CLASSIFICATION PROPOSED BY COMMITTEE OF ENGINEERING COUNCIL

Tentative Classification of Positions in State and Municipal Service Proposed by Engineering Council's Committee on State and Municipal Service	*	Salary Range Proposed for Canadian Service — Usual — Min.	Max.	— Extreme — Min.	Max.	Qualifications Proposed for Canadian Service
Consulting engineer	1	$6,000	....	.....	....	Professional Engr. 12 yrs. exper. (7 in charge)
Chief engineer (major work)	5	6,000	....	$4,800	....	Professional Engr. 7-12 yrs. exper. (3 to 7 in charge)
Chief engineer (minor work)	7	3,900	4,800	3,600	6,000	Professional Engr. 7-12 yrs exper. (3 to 7 in charge)
Chief engineer—deputy	8	3 900	4,800	3,600	5,700	Professional Engr. 7-12 yrs. exper. (3 to 7 in charge)
Engineer	37	3,300	4,020	3,000	4,500	Professional Engr. 5-10 yrs. exper. (2 to 5 in charge)
Senior assistant engineer	40	2,640	3,000	2,400	3,480	Professional Engr. 3 yrs. exper. (2 to 3 in charge)
Assistant engineer	23	2,100	2,580	2,040	3,120	Professional Engr. 3 years' experience
Junior assistant	15	1,680	2,040	1 680	2,160	Professional Engr. 2 years' experience
Senior draftsman	..	Included in professional service				
Draftsman	8	1 260	1,560	.....	....	3 years' experience
Junior draftsman	4	900	1,200	.....	....	2 years' experience
Chief instrument man	..	Included in professional service				
Instrument man	5	1,260	1,560	.....	....	3 years' experience
Rodman	4	900	1,200	.....	....	2 years' experience

* No. of Titles Provided in Proposed Canadian Classification.

Cribbing Protects Banks of Yakima River

Prevention of bank erosion at sharp curves during high-water stages of the Yakima River in Yakima County, Washington, has been effected in several cases by the construction of cribs placed nearly at right angles to the current. These cribs are 20 ft. wide and are of various lengths. They are built of 8 x 10-in. timbers and are filled with river gravel or rock, the filling being placed usually by a dragline plant of the Bagley type, operated by a small hoisting engine. Where it is necessary to prevent the filling from dropping out, the cribs have a bottom of wire netting reinforced by ½-in. cable. Work of this kind is done under the direction of J. O. Greenway, county drainage engineer, Yakima, Wash.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

"Three Openings to One Graduate"

Sir—The letter from Dean Cooley of the University of Michigan, entitled "Three Openings to One Graduate," which you print on p. 433 of your Aug. 28 issue is a most excellent example of the "half truths" used to draw students to our engineering schools. There *was* a shortage of young engineers while the country was at war. Recent graduates had left active practice to go into the Army. The older undergraduates had left schools for the same reason, and the demand for cheap help was greater than ever.

Will the dean state how far back his "several years" goes? Does he pretend his letter to be a true statement of conditions through 1913-16, when men of several years' experience were eager to go to work for from $50 to $90 a month, because nothing better was available? Does he believe it to be true even today when engineers, coming back from Army service, are faced by the kind of advertisements for technical help that fill the pages of all our technical journals? Will he give us a few figures instead of a general statement, so that we may know what percentage of his students, upon graduation, took $200 jobs in the past five years as contrasted with those who went to work for less than $100? Will he further tell us what percentage of his graduates of the past five years are making $200 per month today? In the office where I am employed (a railroad office) about 70% of the engineers are college graduates, several being Michigan men, and with the exception of the chief draftsman they receive from $125 to $150 per month, while the chief draftsman and assistant bridge engineer receive from $160 to $185. These men are all men of from 6 to 15 years' experience.

If Dean Cooley has more requests for engineers at $200 than he can supply, I will put him in touch with great numbers of graduates with from 6 to 15 years' experience who will gladly accept these jobs paying $200 per month.

The deplorable condition of the financial side of an engineer's life in 1915 resulted in the formation of that great body of engineers known as the American Association of Engineers, whose objects include licensing of engineers and the dissemination to the general public of the truth concerning the compensation of the engineering profession, in order that young men contemplating the study of engineering will know the meager financial returns to expect upon their graduation.

The fact that this organization has voiced the sentiment of the rank and file of the profession is evidenced by its phenomenal growth in four years' time to a present membership of about 7000 active and militant members.

These vague, general statements made by men such as Dean Cooley are a shame and disgrace to the engineering schools of the country. They are the visible result of a frantic but vain effort to avoid a decrease in the student body. No great success can be built on an untruth, and until our schools see that and act accordingly, they will be a big hindrance to all efforts to gain respect and recognition for the profession.

Cleveland, Ohio. T. J. BRENNAN,
Assistant Engineer, New York, Chicago & St. Louis Railroad.

[Mr. Brennan's letter was submitted to Dean Cooley, who replied as follows:—EDITOR.]

Sir—I am glad of the opportunity to comment on Mr. Brennan's letter. I think myself that my statement (*Engineering News-Record* of Aug. 28, 1919, p. 433) purporting to answer Mr. Harris' letter headed "Stop College Supply of Graduate Engineers" (July 17, 1919, p. 141) was loose. I should have been more exact. But it did not occur to me that there was—and I do not believe there is—any very general ignorance of the fact that the demand for engineer graduates has been greater than the supply.

In view of Mr. Brennan's criticism, let me tighten up a bit. First let me say that I had no thought of advertising. With the exception of the *Michigan Engineer* published annually, and the *Michigan Technic* published quarterly, we carry no advertisement, and have not carried any since our card was cut out of *Engineering News* fifteen or twenty years ago. On the contrary, our regents, or some of them, because of the difficulty of supplying the necessary funds, have favored discouraging the growth of the College of Engineering. But it would grow in spite of them. Let me give some figures. What is true here at Michigan is, I believe, true of engineering schools in general.

In 1898-99 our attendance in engineering was 245. Ten years later it was 1373 (including summer session), and in 1918-19 it was 4033. But this number includes 2258 students taking special war courses, so that the regular students numbered 1775 (architectural students are excluded). From 1907-08 our engineering attendance fell gradually to 1248 in 1911-12, and then rose gradually to 1534 in 1914-15. Interestingly, this depression period, while it precedes, corresponds to the years 1913-16 referred to by Mr. Brennan It apparently shows that the attendance in colleges is some index of the demand for engineers.

It is a fact that the demand for our graduating engineers has for several years been greater than the supply. By *several years* I mean fifteen at least, and I think twenty would be nearer. It embraced the dull years referred to by Mr. Brennan. The increased demand started soon after the Spanish-American War (1898); and at no time since have we ever had more than enough graduates to meet it.

Where I think Mr. Brennan makes his mistake is in assuming that the conditions in railroad engineering apply generally to all engineering fields. It is notorious that professional railroad engineers have always been underpaid. Had the engineers now engaged in railroad engineering sought employment in other fields for which they might have fitted themselves they would no doubt be now receiving much larger salaries—several times as large, in many instances.

In 1907-08 the engineering graduates of this university were asked to report their salaries and other earnings. At that time there were 1289 living graduates. In the exchange of annual letters no replies had for

several years been received from 55 of them. Of the 1234 who had been replying regularly 980 answered with respect to their salaries. A large proportion of those who did not answer were recent graduates. Approximately, the salary varied the first year, from $0 to $2000, mean $900; second year, from $500 to $4500, mean $1300; third year, from $0 to $2400, mean $1300; fourth year, from $900 to $5500, mean $1700; fifth year, from $1200 to $4000, mean $1900; tenth year, from $1100 to $9000, mean $2500; fifteenth year, from $800 to $20,000, mean $4100; twentieth year, from $1400 to $15,000, mean $6400. After twenty years the maximum salary varied from $2400 to $12,000, the average maximum being $7600. The minimum salary varied from $1200 to $5000, the average minimum being $2400. The average salary after twenty years was $3600.

The full particulars of this investigation were published in the *Michigan Alumnus* for March, 1910, and include a classification as to occupations—42 in number; also in the *Proceedings* of the Society for the Promotion of Engineering Education, 1909. Similar and more recent information has, I believe, been published by other engineering colleges.

It should be borne in mind that not all students pursuing engineering courses intend to go into engineering. An engineering education is considered a good training for business, and many go directly into business. Our statistics for 1907-08 show that only about two-thirds of our graduates go into engineering and closely allied pursuits. I should expect even a less percentage today.

Engineers are not wholly blameless for the position in which they find themselves—a responsibility which the engineering colleges must share. They have devoted altogether too much time to professional subjects. In their zeal to fit themselves for work in the field of their choice, nontechnical subjects which make for breadth have been sacrificed. Thus they are narrow, are fenced in so that neither can they look out nor can others look in.

Now a word on Mr. Brennan's last paragraph. He indulges himself in accusations that are unworthy of him. He should know that in making such statements, when untruthful, he but accuses himself in the same way. Engineering colleges are *not* engaged in a frantic effort to avoid decrease in student body. They *are* engaged, and very seriously, on plans to take care of what promises to be the largest attendance in the history of engineering education. The accepted applications from new men for admission to our engineering college is today almost precisely double what it was at the same date of any previous year. Already there are 465 admissions as against a total freshman class of 430 last year. And the opening of college, at this writing, is yet three weeks off.

M. E. COOLEY,
Dean, Colleges of Engineering and Architecture, University of Michigan.

Ann Arbor, Mich.

[With his letter Dean Cooley incloses the following communications from the heads of engineering departments of the University of Michigan:—EDITOR.]

We could easily have placed two to three times the number of graduates granted degrees June last, conditions being the same as in any previous year since I have been at the university. We were unable to supply a single man to the telephone industry, in any of its branches. The telegraph industry asked for three men for one division of its work. We were able to supply but one man. One large power company has a standing order for six men per year. We sent them three. We supplied men to but two of the machinery manufacturers and were unable to supply a half dozen other concerns, all good ones.

These conditions are typical. The initial wage is usually but $95 a month, although the telephone industry is now making the initial wage $100. The low wage and slow progress of many engineers is about what they deserve. Our men do not complain of slow progress. I have been unable to place any of our graduates during the past three years in positions which seek men of two or three years' experience. Our men do not care to quit their jobs.

It is significant that even at a decent wage schedule, we have difficulty in persuading men of the sort we desire to leave industrial jobs, to go into teaching work. Men of the right sort earn in the neighborhood of $2500, within four or five years of graduation.

J. C. PARKER.
Professor of Electrical Engineering.

The writer has had the responsibility of placing the civil engineers of the last eight graduating classes in positions. Since 1912 every American male graduate has been placed in a position at once. Four of the five women who have graduated were assisted to positions, and several foreign students, including four or five Chinese, seven or eight South Americans, an Austrian and a Persian, have been placed in positions.

It is interesting to note that one of these women graduates is receiving over $2000 per year, one is receiving $1800 and one $1600. They have been out three and four years. One South American of the class of 1913 is receiving between $3500 and $4000 per year, and the other foreigners are receiving from $100 to $200 per month.

Considerable work was involved in placing all of the members of the classes of 1913 and 1914, but by commencement day practically every one had been placed. In those years salaries ranged from $60 to $85 on graduation. The 1915 and 1916 classes were all placed without difficulty, while the small classes of 1917, 1918 and 1919 have been in great demand and I could have placed a much larger number.

Every year since I have been here some of the more mature men who have had two or three years' experience prior to graduation have been placed at salaries well over $100 a month, one member of this year's class returning to a former employer at $200 per month, and the average for this year's class is probably $160 per month.

Since I have been connected with the university we have given well over 500 bachelor's degrees in civil engineering. I have been in touch with perhaps 150 of these men. So far as I know, most of them are doing well. Several are receiving over $3000 per year and I know of at least 100 who are receiving from $2000 to $3000 per year with less than ten years of practice since graduation.

There is considerable difference from year to year in the demand for men in different fields of work. The calls for structural engineers are always far beyond our

ability to furnish men. In general, the initial salary in this field is low, but many of our men have risen to the front and are receiving large salaries in sales and administrative positions with structural and contracting firms. The demand for highway engineers and for men trained in municipal work, in this section of the country, is in excess of the supply, while high-class men thoroughly trained in sanitary engineering have had little difficulty in finding good positions.

I do not encourage our students to specialize in railroad engineering courses which I am teaching. Michigan is one of the few schools which require no work in railroad engineering. My own experience of a number of years as a railroad engineer and my touch with conditions in railroad engineering through wide acquaintance and through membership in the American Railway Engineering Association have convinced me that the managing officials of the railways have in general failed to appreciate the high quality of service that is being rendered by the railway engineers of the country. It is a regrettable fact that other fields are more attractive. For example, six or eight counties in Michigan are paying from $4000 to $10,000 per year for county highway engineers. Within the past few years similar salaries are being paid to several city engineers and assistant city engineers in this state. Aside from a few chief engineers of the larger railroads, I presume it is safe to say that there are very few men in the engineering department receiving over $4000 per year.

Within the past six weeks we have had calls for men in teaching positions, one at $1800, one at $2000, and two at higher figures; a call from a firm of architcets for three men on sewer and water-works design at $2000 to $2400; a call from a consulting engineer in Ohio for two men with two or three years' experience at $1800 to $2400 per year; a call from a large manufacturing concern in Detroit for three men, one with knowledge of reinforced concrete, one with knowledge of steel work, and one with all-round building experience, salary ranging from $2400 to $3600; one position in highway engineering offering $175 per month, and standing orders from two of the largest cities in the state for engineers with from one to five years' experience. Not one of these places could be filled.

Last week a Government engineer called me up and asked for a draftsman with seven to ten years experience, salary $150 per month. His office is located in a city which is paying axmen and rodmen $1600 a year minimum.

It must be borne in mind that not all of the men who graduate from the colleges in engineering courses have the personal qualifications which will enable them to reach high places in the profession. A large number of men in each of our classes will remain in the ranks of employees throughout their lives. During my professional experience of nearly 35 years I have never seen a time when there was not a goodly number of dissatisfied engineers railing against the limited opportunities of the profession. This condition will always prevail, because men are but human and a large percentage of them will fail to reach the goal of their ambition. Nevertheless, my own experience and that of many of my friends who started as I did at the bottom, convinces me that the profession of engineering offers greater reward than any of the other learned professions. With the demand for trained engineers which the University of Michigan cannot begin to fill at the present time, it would be folly for us to limit our work in the training of men for engineering positions.

H. E. RIGGS,
Professor of Civil Engineering.

In the mechanical engineering department there were about 160 requests for men and we had approximately 50 graduates this year. This 160 is a very conservative count, as many of the larger concerns, instead of giving the exact number of men, requested that we send them a number or several, and in making the count I have assumed that they would take two or three or four men. One of the larger manufacturing concerns requested outright 10 men. I was also advised orally by one of the very large automobile manufacturing concerns that it would take all the men that we could send it. Long before this year's class completed its work in June every man was located.

The salaries paid this year's graduates range from $95 per month to $150 per month. A few of them obtained positions paying as high as $175 per month, with the stipulation that if they showed promise their salaries would be increased within three months to one year.

We have a number of men who graduated in mechanical engineering eight or nine years ago and are now getting anywhere from $10,000 to $25,000 and $30,000 a year, and very few of them are getting under $4000 a year. I fully believe that their average would be over $5000 per year.

H. C. ANDERSON,
Professor of Mechanical Engineering.

The demand for chemical engineers, during the twenty years of our department's history, has always been much greater than we could supply, and I believe that with but few exceptions the demand has been triple all that we could supply.

So far as I can learn, we have not a single graduate who is out of a position. I do not have figures as to the average salary of our men who graduated last June, but the employment manager of one of our very large corporations told me recently that $125 a month was his average salary for a chemical engineer just out of college. This has been confirmed by others.

A. H. WHITE,
Professor of Chemical Engineering.

The demand for our graduates in naval architecture has been steadily increasing during the past five years, I have no figures at hand for the years preceding 1919, but I know that the Government departments doing naval work have tried for a number of years to get all of our graduates into the service. In addition, we have had opportunities for placing with private yards a greater number of men than we graduated. This last year the demand has been exceptionally great. We had specific requests for more men than were available and, in addition, requests from three concerns for "several" men. I believe that any one of these three would have gladly taken all the men we graduated and that we could have found places for four times as many men.

These men went to work at rates which ranged from $130 to $150 a month, with promises of an increase in a few months.

E. M. BRAGG,
Professor of Naval Architecture and Marine Engineering.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

CONTRIBUTIONS *to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Pipe Is Taken Up Without Uncoupling

IN REMOVING an old 6-in. screw-joint heating main extending across the grounds of the University of Wisconsin, at Madison, the work was facilitated by the taking up of the main in lengths of 120 to 160 ft., so that only a few of the joints had to be disconnected in the trench. Most of the separations were made at the bolted expansion joints. For hoisting each long stretch of pipe, two differential chain hoists were used, the blocks being hitched to trees or telegraph poles some 6 ft. from the trench, while the chains were attached to rope slings on the pipe. In this way two men could remove a stretch of main, pulling it up out of the trench and over the spoil bank.

Flanging Machine, for Thin Steel Plates, Built on the Job

PLACING a steel-plate drip floor on the 550-ft. arch bridge by which the Grand Trunk Ry. crosses the Niagara River gorge at Niagara Falls, N. Y., required a large number of sheets of $\frac{3}{16}$-in. steel plate to be flanged on both edges. These sheets are about 4 ft. wide by 9 ft. long, and are placed transverse to the bridge, over the stringers, the ties resting on them by means of wooden shim blocks. The joint between successive sheets is made by stove bolts passing through the upstanding flanged edges of the plates and a cover strip of sheet metal bent down over the joined flanges. As the sheets were received on the job plain, it was necessary to flange them in the field. The contractor, the Terry & Tench Co., of New York, built a flanging machine according to a suggestion of C. E. Fowler, consulting engineer, and it has done the work very successfully.

As described by Mr. Fowler, the machine is somewhat similar to the ordinary tin-shop bender, but is made of 12 x 12 timbers driftbolted together. The working edges of the two main bending timbers are faced with old steel angles. The hinge timber is trussed by a hog-rod, and is turned by a pair of handles about 8 ft. long, actuated by lines running to the niggerhead of a small hoisting engine. The plates are clamped in position in the machine by a counterweighted timber held down by two levers similar to the end-raising levers of an old-fashioned swing bridge. A stop near the back end of the table on which the plate is entered enables the plate to be set so that the flanges are made at the correct spacing. The angles of the working faces of the bending timbers were determined by trial, so as to allow for the spring of the plate when pressure is released.

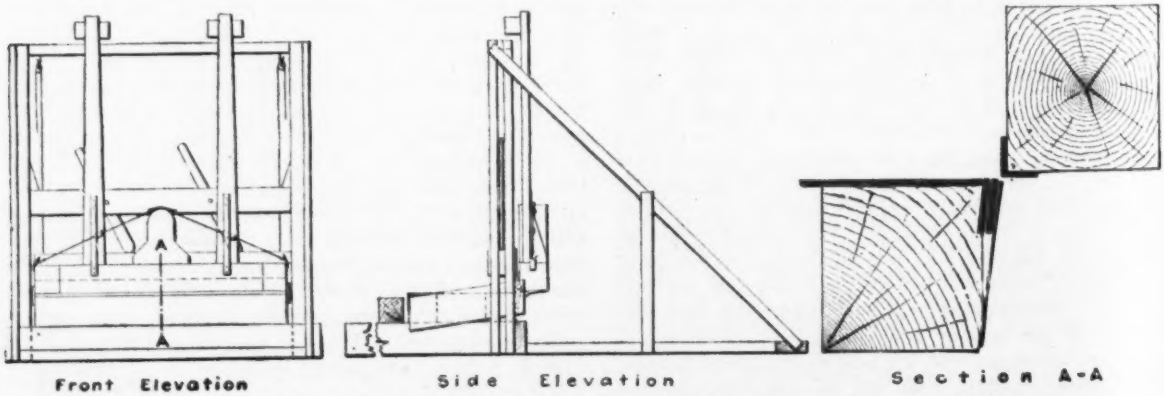
Three men work the machine. From 40 to 50 plates are flanged on both edges per day, and the machine has operated without hitch or delay.

Other Articles in This Issue of Interest to Contractors:

Constructing a 98-Kilometer Water Conduit in Chile — Page 593
Plans for Earth-Dam Construction Involve Large Use of Machinery — Page 612
New Features in Indiana's Concrete-Road Specifications — Page 611
Extending the Galveston Sea Wall — Page 617

Curb Protects Stock Pile in Street

STOCK piles of concrete materials in city streets, for building or other work, may be subject to considerable loss by wheels and hoofs passing over the edges of the piles. The dispersion of material over the street may cause an unsightly appearance. A simple method of preventing this, employed by a Chicago contractor, was to build a curb of heavy timbers which were being used on the work, thus avoiding a spreading of material and keeping vehicles for encroaching upon the stock pile.



FLANGING RIG FOR $\frac{3}{16}$-INCH STEEL FLOOR PLATES OF NIAGARA ARCH BRIDGE

We Must Have a Homogeneous People

The Postal Zone Law Is a Menace to Our Nation

By Congressman Frank W. Mondell
of Montana
Floor Leader of the Majority Party in Congress

I AM opposed to the zone system for the dissemination of news, ideas and information because I am of the opinion that the establishment and maintenance of such a policy would, in the long run, have a most unfortunate, harmful and regrettable effect upon the American people.

If we are to maintain peace, order and justice under the institutions of free government, within our borders, we must have a homogeneous people guided by the same principles and inspired by the same ideals. This condition essential to the maintenance of free government can only be secured by the widest possible circulation of those instruments and instrumentalities which inform, mould and affect public opinion.

Any policy which tends to make us provincial or parochial as a people, which tends to build up zones of influence and information, is a policy not only harmful but one that long continued and widely extended would prove fatal to free institutions. On the other hand, a policy which makes equally available to the people in all parts of the country the journals and magazines which convey information, carry current argument, analysis and entertainment, tends to maintain those conditions essential to our institutions.

Those whose views or arguments for the zone system are based primarily or largely on its effect, or alleged effect, on postal revenues, or the profits of the publishing business, fail utterly to grasp or realize the larger and infinitely more important aspects of postal systems as they affect the national life. If it be a fact that the flat postal rate on newspapers and magazines has been unduly low, that is a matter for consideration by the Post Office Committee, having in view the traditional policy of the American people. The fact that some people have been able to make a considerable amount of money in the newspaper and magazine business is, of course, one of the matters that a committee would consider in this connection, but it is by no means conclusive that a policy is wrong because some people have been able to make money under it—many having the same opportunities and privileges failed utterly.

The demand for the establishment and maintenance of a zone system is particularly lame and illogical when it is made by those who are urging a flat rate of one cent on letters. Such people to be logical should insist upon a zone rate for letters as well as papers and periodicals. Neither is the argument for a zone system strengthened by exaggerated statements of losses to the postal revenues under a flat rate. Undoubtedly the former flat rate did not wholly reimburse the postal revenues, but the most superficial examination of the matter renders ridiculous exaggerated statements of alleged losses. To the argument that publications enjoying the second-class rates are devoted more or less to advertisement, I offer the suggestion that a national dissemination of attractive advertisements is not without its educational benefits.

I have neither urged nor considered this as a party question. It involves a national principle affecting every man, woman and child in the Republic, and has never been considered in a partisan way by anyone so far as I know. I urged this repeal before the previous Democratic Congress, as I shall before the present Republican Congress—not on party or partisan grounds, but on the broad platform that such a policy tends to circumscribe and provincialize our national life to our great harm as a people.

F. W. MONDELL.

NEWS OF THE WEEK

New York, September 25, 1919

Baltimore Water-Works Enlargement Recommended

New Dams, Duplication of Conduit and of Mechanical Filters and Other Additions to Cost $25,000,000

By Walter E. Lee

Water Engineer, Baltimore, Md.

A program for increasing the water-supply of Baltimore to an ultimate capacity of 200,000,000 gal. a day has just been submitted by the writer to Mayor William F. Broening and the Board of Estimate. The program calls for an outlay of $8,000,000 to meet the immediate needs of the city and to avoid the impending water shortage, with an ultimate outlay of $25,000,000 to place the water-supply of Baltimore in a condition to prevent the question of sufficient water from recurring every 10 years, as in the past, and to avoid further consideration of the subject for at least 30 years.

The Gunpowder River now constitutes the sole source of the water-supply for Baltimore, by an impounding reservoir of 2,000,000,000-gal. storage, none of which, however, is available in times of drought because of the head required to overcome the frictional losses in a 12-ft. tunnel 7.5 miles long between the source of supply and the city.

The daily consumption by the city now exceeds the average yield of the Gunpowder River, and an additional storage of 23,000,000,000 gal. is to be obtained at an estimated cost of $2,031,000, by constructing a dam 123 ft. high on the Upper Gunpowder Falls, a tributary of the main Gunpowder River. No connecting conduit is necessary, as the total storage of this reservoir is available by opening the outlet gates and allowing the water to flow down the river to the present tunnel intake.

The report recommends that when the natural flow of the Gunpowder River and the additional storage to be immediately provided do not meet the city's requirements, a dam creating a 12,000,000,000-gal. reservoir be built on an adjacent stream, Deer Creek, at an estimated cost of $5,293,500.

As the "peak" demand on the present mechanical filtration plant of 128,000,000 gal. per day capacity overloads the plant by 32%, an additional mechanical filtration plant is recommended of 128,000,000 gal. per day capacity, at an estimated cost of $2,700,000, whose clear-water reservoir would connect with that of the existing filters at the same level.

Frictional losses in the existing tunnel between the source of supply and

(*Concluded on page* 632)

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 505 Pearl St.

American Society Members at New York Discuss Public-Works Bill

Discussion of the Jones-Reavis bill proposing a national Department of Public Works was the main business of the meeting of the American Society of Civil Engineers at the Engineering Societies' Building, New York City, Sept. 17. George W. Fuller, consulting engineer, opened the session by explaining the contents of the bill and pointing out the principal advantages which would result from the creation of a Federal public-works department. At the present time, Mr. Fuller said, thirty different bureaus are engaged in engineer functions. Such diversity of effort and lack of coördination were pointed to as one reason for the creation of the Federal department. Mr. Fuller also touched upon the matter of competition among existing bureaus as an objectionable feature of the present scheme of distributing among the different departments the work that should, from its engineering nature, be controlled by a single head. Particularly is this competition apparent in the matter of securing appropriations.

The benefits to be derived from the passage of the bill, Mr. Fuller explained, were efficiency, economy and businesslike methods in the administration of our public-works construction.

(*Concluded on page* 633)

Galveston Suffers No Storm Damage

City Engineer C. A. Holt, Jr., Tells How All Engineering Structures Resisted Hurricane's Force

Galveston's engineering works are none the worse for last week's severe storm. All structures stood the test, and public utilities continued to function. At the request of *Engineering News-Record*, C. A. Holt, Jr., city engineer of Galveston, has supplied the following facts as to the effects of the storm:

"The outer edge of the tropical hurricane which passed Galveston to the southwest Sept. 13 made no impression on the various engineering works now under construction or completed in and around Galveston. Approximately 3300 lin.ft. of the seawall extension east of 6th St., now under construction by the Government, was injured in no way by the very heavy sea coming in from the Gulf, although the structure was unsupported by fill. The arch work now under construction on the causeway, together with the old original arch structure, remains intact.

"The temporary wagon bridge, a county structure erected in 1916 to carry vehicular traffic across Galveston Bay during the reconstruction of the causeway, suffered no damage; not a timber in the entire structure became displaced. The fill back of the Galveston County portion of the seawall, which originally had an elevation of 19 ft. above mean low tide at the crest 100 ft. from the wall, and which after the 1915 storm was raised to El. 21 at 200 ft. from the wall, fulfilled every service expected from it. That good old seawall designed by Noble, Robert and Ripley, standing like the Rock of Gibraltar, has been tried again and not found wanting.

"The City of Galveston suffered no loss whatever, and all public-service corporations continued to give efficient service uninterruptedly."

Theodore P. Shonts Dies in New York

Theodore P. Shonts, president of the Interborough Rapid Transit Co., New York City, and former chairman of the Isthmian Canal Commission, died in New York Sept. 21 at the age of 63, following an illness of several months.

In 1905 Mr. Shonts was appointed chairman of the Canal Commission by President Roosevelt. He had already become prominent as a railroad constructor and operator, having been in charge of the building of portions of

the Iowa Central R.R. and other lines, and having served as president of the Minneapolis & St. Louis R.R., the Toledo, St. Louis & Western R.R., and the Chicago & Alton Railroad.

After his graduation from Monmouth College, Monmouth, Ill., he became a bookkeeper and later studied law, becoming a member of a law firm in Centerville, Iowa, of which the head was Gen. F. M. Drake, who was also vice-president of the Iowa Construction Co., organized to carry out large railroad-building contracts. Mr. Shonts was placed in charge of construction on the new line of the Iowa Central, by the Iowa Construction Co. In 1882 he became general superintendent of the Illinois & Iowa R.R., and later became president, having acquired control.

As chairman of the Canal Commission from 1905-1907, he built up the organization that carried through the construction of the Panama Canal. He was then appointed president of the Interborough company to undertake the coördination of New York City's rapid-transit facilities.

Canadian Engineers Hold Fifth Professional Meeting

What is considered to have been one of the most important gatherings of technical men in eastern Canada was the three-day session of the fifth general professional meeting of the Engineering Institute of Canada, held at St. John, New Brunswick, Sept. 10-12.

One of the papers was read by C. O. Foss, chairman of the New Brunswick Water-Powers Commission, who outlined in a comprehensive manner the possibilities for hydro-electric development in New Brunswick. As the City of St. John is lighted by electricity generated in steam plants, and in view of the increased cost of labor and coal, Mr. Foss pointed to the necessity for increased rates or additional electrical development.

Other discussions included those on highway construction and bridge work, experimentation with high-tension, high-frequency electric current, engineering problems connected with the use of telephone cables, and heating problems produced by some of the modern methods of building construction. During the three-day session trips were made to manufacturing plants and points of general engineering interest.

The sessions were presided over by the President of the Engineering Institute of Canada, Lieut. Col. R. W. Leonard.

Iowa Governor Appoints Board to Examine Engineers

Governor Harding has announced the appointment of the Board of Examiners required to put into effect the Iowa Engineers' license law, as follows: Seth Dean, Glenwood, chairman; Karl C. Kastberg, Des Moines, secretary; Alvin LeVan, Fort Dodge; L. M. Martin, Atlantic, and F. W. Stubbs, Oelwein, vice-chairman.

Movement To Unionize All New York Municipal Employees

A movement to organize all employees of the City of New York, including firemen and policemen, into one great union affiliated with the American Federation of Labor, to obtain wage increases to meet the increased cost of living, was started at a meeting Sept. 18, presided over by Burt L. Schneider, president of the Union of Technical Men. Mr. Schneider outlined the purpose of the conference and informed the delegates that they should receive a wage increase of 65% to meet the high cost of necessaries.

Thirty members of the executive councils of 15 city employees' unions or associations, having a total membership in excess of 100,000, attended. They unanimously ratified the proposal to form the Central Union, as it was tentatively named, and were instructed to put the proposal before the full membership of their respective organizations. If the plan is adopted at the meetings of the organizations two delegates from each union will report back, and the actual work of forming the big union will be undertaken.

The following organizations were represented at the conference: The Uniformed Firemen's Union, Police Benevolent Association, Teachers' Union, Union of Technical Men, County and City Public Service Clerks, Stenographers and Bookkeepers' Union, Water Meter Inspectors' Union, Health Inspectors' Union, Building Inspectors' Union, Tenement House Inspectors' Union, Street Cleaners' Union, Teamsters' Union, Keepers' Union and Matrons' Union. These organizations, as was pointed out at the meeting, include practically all of the workers under salary to the city.

Another step decided upon by the meeting was the organization of city employees as yet not members of any union. This, too, however, was left to wait upon the ratification of the Central Union by the organizations represented at the meeting.

A mass meeting of the Union of Technical Men will be held Oct. 7, according to a current announcement.

Mayor Hylan has demanded of the heads of all city departments that "agitators" be eliminated from the payrolls by the abolition of provisions for their positions in next year's budget.

State Registration of Engineers Begins in Oregon

A state board of engineering examiners has been established in Oregon in accordance with an act for the registration of "professional engineers" passed at the last session of the legislature. The board has held several meetings, has adopted rules and regulations for conducting examinations, and announces itself "fully organized and prepared to receive applications for registration of the professional engineers and others who expect to practice engineering in Oregon." [An abstract of the act and an important amendment to it were published in *Engineering News-Record* of Mar. 27, 1919, p. 617, and May 8, 1919, p. 911.]

Members of the board appointed by the Governor to serve for the two years which will end July 1, 1921, are as follows: F. S. Baillie and W. B. Dennis, mining engineers; R. R. Bartlett and O. Laurgaard, civil engineers; G. A. Covell and F. Hesse, mechanical engineers; E. G. Hopson and J. H. Lewis, hydraulic engineers, and F. D. Weber, electrical engineer. The officers elected by the board are: O. Laurgaard, president; F. D. Weber, vice-president; A. B. Carter, secretary. Headquarters are at 520 Corbett Bldg., Portland.

Under the terms of the act all who desire to practice in any branch of professional engineering in Oregon after Jan. 1, 1920, must register before that date with the newly created board. A statement of experience must accompany the application for registration. Engineers with six years' experience in the practice of "professional engineering" who apply before Jan. 1, 1920, will be registered without examination. Thereafter all applicants will be subject to examination.

Seattle Engineers Protest Against City's Pay

The Associated Engineering Societies of Seattle recently sent to the Mayor and the City Council a protest against what is alleged to be inadequate compensation in five grades of the city's engineering service. The association is backing a movement to secure adequate pay for all classes of technical men in public service, city, county, port and state.

Railway Maintenance Convention

Both the economic and the practical sides of maintenance work were covered at the annual convention of the Roadmasters' and Maintenance-of-Way Association, held in Chicago Sept. 16-18. The labor question was prominent. "Methods of Improving the Efficiency of Track Labor" was the subject of a paper by C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific R.R., while labor supply was discussed by Hugh Reid, of the United States Department of Labor, and two reports showed the economic value of labor-saving appliances under present conditions. Besides a paper on "The Equation of Track Values," by W. R. Wiltsee, principal assistant engineer of the Norfolk & Western R.R., the other subjects included maintenance work at passenger and freight terminals, roadway drainage and ditching, and the use of stone and bituminous paving instead of planks at road crossings. The war work of the American railway engineer regiments in France was reviewed by Samuel M. Felton, president of the Chicago Great Western R.R., who was director general of military railways.

Ketchum Head of Civil Engineering College, Pennsylvania University

Milo S. Ketchum, dean of the College of Engineering, University of Colorado, structural engineer of national prominence, member of Crocker & Ketchum, consulting engineers, Denver, Colo., author of several engineering treatises and engineer handbooks, and recently in charge of the construction of important explosive plants at Nitro, W. Va., has been appointed to the position of Professor-in-Charge of the Civil Engineering Department of the University of Pennsylvania.

Mr. Ketchum has always been a leading figure in the advancement of tech-

MILO S. KETCHUM

nical education since his appointment as assistant professor of civil engineering at the University of Illinois in September, 1899. His pursuit of technical instruction has been interrupted by periods of professional practice. In February, 1918, he received a leave of absence from the University of Colorado to become assistant director of munitions in charge of the Nitro, W. Va., plant. His appointment was made by D. C. Jackling, director of munitions, the Nitro plant being one of a series of such plants then being built under the direction of Mr. Jackling.

Mr. Ketchum was graduated from the University of Illinois with a B.S. degree in civil engineering in 1895, receiving his C.E. degree five years later from the same institution. Even while an undergraduate at the Illinois institution, he served as an instructor in summer surveying at the School of Mines at Houghton, Mich. From September, 1895, to June, 1897, he served as assistant instructor in civil engineering at the University of Illinois, devoting his summer to the actual practice of his profession in Urbana, Peoria and Charleston, Ill. From June, 1897, to June, 1899, he was designing engineer and construction agent for the Gillette-Herzog Manufacturing Co., Minneapolis, Minn., and in that capacity designed and erected highway and electric-railway bridges and mine and smelter buildings amounting in cost to over $150,000. He also superintended the erection of the Franklin steel stamp mill, at Grosse Point, Mich.

From September, 1899, to September, 1903, he was assistant professor of civil engineering, University of Illinois. At the same time he did consulting work, designing numerous highway bridges for Champaign and Platt Counties, Illinois, reported on bridges at Danville and La Salle, Ill., and for Vermilion County, Illinois, and from April, 1902, to March, 1903, was consulting engineer with the Illinois Valley Traction Co., while that company was constructing the electric railway from La Salle to Ladd, Ill. In that work he revised the location of a part of the land and designed and superintended the erection of bridges. He was contracting manager for the American Bridge Co. during 1903 and 1904, making his headquarters at Kansas City, though he spent part of the time at Butte, Mont. He left that company to become professor of civil engineering, University of Colorado, being made dean of the College of Engineering, University of Colorado, in 1905.

His publications include a surveying manual, of which he was co-editor with W. D. Pence; "Design of Steel Mill Buildings and the Calculation of Stresses in Framed Structures," "Design of Walls, Bins and Grain Elevators," "Design of Highway Bridges," "Design of Mine Structures" and "Structural Engineers' Handbook."

He is a director of the American Society of Civil Engineers, a fellow of the American Association for the Advancement of Science, a past president of the Society for the Promotion of Engineering Education, and a member of the American Society for Testing Materials and of the American Railway Engineering Association.

Hugh M. Wilson Dead

Hugh M. Wilson, for six years first vice-president of the McGraw Publishing Co., until his resignation in January, 1917, died suddenly Sept. 19 at his home in Stockbridge, Mass. To the McGraw organization Mr. Wilson brought a rich experience in the field of technical journal publication, and he was an important factor in shaping and putting into effect the company's policies.

Mr. Wilson's first journalistic work was as a reporter for the daily press of the Middle West. In 1889, however, he joined the staff of the *Mississippi Valley Lumberman*, and since that time he devoted his great energy and ability to the development of magazines in the trade and technical field. It was through the medium of the *Northwestern Railroader* that he entered the railway field in which he was to become a great leader. That journal was soon consolidated with the *Railway Age*, Mr. Wilson becoming secretary-treasurer of the new organization. His dual training in editorial and business affairs proved so valuable that he subsequently undertook, in addition to his former duties, those of manager of *Railway Age*. He was elected president of the company in 1899. In 1906 the Wilson Co. was organized and took over the publication of *Railway Age* and the *Electric Railway Review*. Two years later, however, Mr. Wilson sold both papers. The *Railway Age* was consolidated with the *Railway Gazette* while the *Electric Railway Review* was purchased by the McGraw Publishing Co., and combined with the *Electric Railway Journal*. After a year as vice-president of the Barney & Smith Car Co., of Dayton, Ohio, Mr. Wilson joined the McGraw Publishing Company.

His marked success as a publisher was due to his ability to sense the trend of events, to keep before him certain clear ideals as to the place of the magazine in its industry or profession, and to enlist the wholehearted support and loyalty of those who worked with him. His influence, not only on the journals with which he was connected, but on the whole field of trade and technical journalism, will be a lasting one.

Baltimore Water-Works Enlargement Recommended

(*Continued from page* 630)

the city will so grow, with any additional flow through it under heavier demands in the next few years, that the lift of the centrifugal pumps taking water from it will be so increased as to cause an interruption in pumping service. To meet this condition by reducing frictional losses, an additional 12-ft. tunnel, costing approximately $3,600,000, is recommended for immediate construction.

It is also recommended that when the capitalization of the annual pumping charges for lifting the water from the Gunpowder tunnel to the mixing basin at the filtration plant exceeds $2,641,700, the existing dam on the Gunpowder River at Loch Raven be increased from El. 192 ft. to El. 234 ft., to provide sufficient head to deliver the water to the mixing basin of the filters without pumping.

This higher dam would impose a greater pressure on the existing tunnel from the river to the city, and as portions of the ground above it are considerably below the hydraulic grade line, it is recommended that the existing tunnel be reinforced and strengthened, at an estimated cost of $593,000.

The area of Baltimore was increased from 31.3 to 81.2 square miles by a legislative act passed in 1918. Several private water companies now serve a part of the population thus added to Baltimore, but requests for extensions of the city service are steadily growing.

Three new equalizing reservoirs and one pumping station to supply this additional territory are recommended at a total cost of $7,893,000.

Death of E. O. Sachs, British Fire Prevention Expert

Edwin O. Sachs, chairman of the Executive of the British Fire Prevention Committee, and one of the world leaders in the work of fire prevention, died at his home in London, Sept. 9, at the age of 49 years. At the request of this journal Ira H. Woolson, consulting engineer of the National Board of Fire Underwriters, and a co-worker with Mr. Sachs in many international fire-prevention campaigns, prepared the following note:

"A gentleman of culture and an architect by profession, Mr. Sachs early recognized the tremendous fire hazards existing in English cities due to the prevalence of combustible construction and to defects in coöperation and equipment in the fire-fighting forces. His intelligent grasp of the subject and forceful methods of presenting the facts soon won to his support many of the clear-thinking public officials of London and other prominent English cities, as well as representatives of the technical professions and chiefs of fire brigades. Taking advantage of the state of public mind following the great Cripplegate fire in 1897, this group of fire-prevention enthusiasts founded the British Fire-Prevention Committee in 1898, and immediately proceeded to establish a testing station in which to determine the fire-resisting merits of building materials and construction. Mr. Sachs was the head of the committee's activities from its organization until his death. He was ably assisted by the group of officials and technical men who gave unselfishly of their time and money in support of the enterprise.

"Immediately after organization, the committee began the publication of its well known series of little 'Red Books.' The first issues were devoted to discussion of fire-prevention and fire-fighting problems and reports upon great fires which occurred in Europe and America. In all this Mr. Sachs took the 'laboring oar' and wielded his pen indefatigably. Later the reports of fire tests conducted by the committee were published, and the 'Red Books' now comprise over 200 numbers, and constitute a valuable library upon the subjects of fire prevention and fire protection.

"While Mr. Sachs was jealous of the reputation and accomplishments of his committee, he was at the same time generous in his recognition of competent and reliable work done by others. Numerous reports of notable fires, and investigations conducted in this and other countries, have been published in full in the 'Red Books.' One book gives a full, illustrated description of the New York fire department, written by the late Chief Bonner.

"During the four desperate years of the war the committee devoted itself with untiring zeal to solving for the Government many of the vital fire-protection problems which confronted England. Among these were protection of life and property from aërial bombardment; the safeguarding of hospitals and cantonments from fire; and many others of varying character. Letters from Mr. Sachs to a friend in this city during this period tell of the high pressure under which the committee was working, and its exhausting character. It is not unlikely that the severe strain was too much for his not over-strong constitution.

"Mr. Sachs was the author of several books, of which perhaps the best known are 'Modern Opera Houses and Theaters' and 'Fires and Public Entertainment.' The former is in two large volumes profusely illustrated. He was always a strong advocate of generous and properly protected exits from public amusement buildings."

Highway Bond Issue Authorized in Maine

Maine has now been added to the large number of states which are inaugurating extensive highway construction campaigns. At a recent election the voters authorized the issuing of an additional sum of $8,000,000 for highway construction purposes, making the total legal bonded indebtedness for this purpose $10,000,000. The sentiment for good roads is shown by the vote of 5 to 1 in favor of the proposal.

Public Utilities Commissioners to Meet in Indianapolis

The 31st annual convention of the National Association of Railway and Utilities Commissioners will be held in Indianapolis, beginning Oct. 14. Headquarters will be at the Claypool Hotel. It is expected that the convention will last for four or five days. The opening address will be delivered by Clyde B. Aitchison, chairman of the Interstate Commerce Commission, formerly of the Oregon Commission.

Minneapolis Will Have Right To Buy Street Railways

Under the service-at-cost street-railway franchise settlement just agreed upon in Minneapolis (subject to referendum vote in December) the city has the option of buying the property of the Twin City Rapid Transit Co. at stated intervals. The valuation fixed for purchase and rate purposes is $24,000,000 as of Jan. 1, 1919, against nearly $26,000,000 as of Jan. 1, 1916, estimated by F. W. Cappelen, city engineer, and nearly $31,000,000 formerly claimed by the company. The company is to be allowed a 7% return on the valuation. The initial fare will be 5c., with variations of 1c. up or down with rises or declines in earnings. The city council will have control over capital increases and purchases. A reserve fund must be created for repairs, maintenance, renewals and depreciation. A street-railway supervisor will be appointed by the city council.

Discuss Public Works Bill

(*Concluded from page* 630)

Under the proposed system, it was believed, the taxpayers would get more for their money and with a single executive head a comprehensive and logical program of construction could be planned and carried out for the best interest of the nation. As a war-preparedness measure the bill was commended by Mr. Fuller, who spoke at some length of the organization and the results accomplished by the Army's Construction Division, where modern business methods were employed. With respect to the effect of the Jones-Reavis bill on the Corps of Engineers, U. S. A., Mr. Fuller argued for a considerate treatment of the military engineer and greater coöperation among the military and civilian members of the profession.

Speaking for the American Institute of Architects, W. D. Blair indorsed the proposal for the national public-works department, pointing out that it would be of benefit to architects in the establishment of a national building policy, something which we do not possess at present.

Representing Marshall O. Leighton, of the Engineers, Architects and Constructors' Conference, C. T. Chenery pointed out some of the advantages of the bill and gave details of the illogical distribution of functions in the existing Federal departments.

From the viewpoint of the contractor, F. J. MacIsaac, president of the General Contractors' Association of New York, indorsed the proposed legislation, pointing out that the retention in the new department of the existing Construction Division of the Army was a desirable feature, particularly as a measure of American military preparedness.

Opposition to the bill was voiced by John A. Bensel, former New York state engineer, who believed that the public is better served by the present organization of our Federal departments. Roger D. Black, until recently Colonel, Corps of Engineers, U. S. A., and a member of the General Staff Corps, opposed the bill, particularly that portion of it which would take away from the Corps of Engineers its river and harbor work. This work, he maintained, furnishes the members of the corps the only practical training in engineering construction which they receive.

The discussion was closed by Alfred D. Flinn, secretary of Engineering Council, who made the point that engineers are apt to regard the benefits to be derived from a national Department of Public Works as too obvious for discussion. Every opportunity should be utilized, he argued, for convincing those outside of the engineering profession of the soundness of the proposed legislation.

It is planned to raise a fund of $100,000 to be used in publicity and educational work in favor of the bill.

Form Connecticut Association of Members of American Society

The Connecticut Association of Members of the American Society of Civil Engineers has been formed, with the following officers: President, Caleb Mills Saville, Hartford; vice-president, Clarence Blakeslee, New Haven; secretary-treasurer, Robert J. Ross, Hartford. These officers, together with Edward W. Bush, Hartford, and William R. Dunham, Jr., New Haven, constitute the board of directors.

Society Activities in Chicago

Active coöperation between the Western Society of Engineers and the Illinois Association of Members of the American Society of Civil Engineers is foreshadowed by steps taken at a meeting of the latter Sept. 16 to discuss this matter. General discussion was preceded by addresses by the following: A. J. Hammond (Am. Soc. C. E. only), J. H. Libberton (Western Society only), C. F. Loweth (member of both societies). One resolution that was passed provided for the appointment of a committee to consider plans for coöperation and to report at a later meeting, while a second authorized the officers to coöperate with other engineering societies of Chicago pending the presentation of this report.

An organized campaign for increased membership, carried out by teams working under the direction of a central committee, has been begun by the Western Society of Engineers.

Ohio Technical Societies To Hold Convention Next Month

A state convention of the engineers and architects of Ohio will be held in Columbus, Ohio, Oct. 14-15, under the auspices of the Association of Ohio Technical Societies. Four principal subjects will be discussed. M. O. Leighton, chairman of the Engineers, Architects and Constructors' Conference, will speak on "The National Department of Public Works"; Dr. F. H. Newell, of the American Association of Engineers, will speak on "Closer Cooperation in the Engineering Profession"; Charles Whiting Baker, consulting editor of *Engineering News-Record*, will address the convention on the "Compensation of Engineers and Architects," and Prof. Gardner S. Williams, of the University of Michigan, will discuss the "Registration of Engineers and Architects."

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Assistant examiner, Patent Office, Washington, D. C., $1500 to $1740 per year, Sept. 17 to 19 and Nov. 19 to 21. File applications in time to arrange for examination at place selected by applicant.

Senior highway engineer, Bureau of Public Roads, Department of Agriculture, $2220 to $4000 per year, Oct. 21, File applications before Oct. 21.

Engineer, $3000 per year; assistant engineer, $1800 to $2880 per year; junior engineer, $1200 to $1740 per year; engineering draftsman, $1200 to $3000 per year, Reclamation Service. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION: Tremont Temple, Boston, Sept. 30, Oct. 1-3, Albany, N. Y.

NATIONAL SAFETY COUNCIL, 168 Michigan Ave., Chicago; Oct. 1-4, Cleveland.

AMERICAN SOCIETY OF NAVAL ENGINEERS: Secretary, Lieut. Com. F. W. Sterling, U.S.N., Navy Department, Washington, D. C.; Oct. 7, Washington.

AMERICAN PUBLIC HEALTH ASSOCIATION: 169 Massachusetts Ave., Boston; Oct. 27-30, New Orleans.

CITY MANAGERS' ASSOCIATION, 1812 Tribune Bldg., New York City; Oct. 29-31, Indianapolis.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS; 304 E. Walnut St., Bloomington, Ill.; Nov. 11-14, New Orleans.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS; 29 W. 39th St., New York City; Nov. 13, New York City.

The American Association of Engineers announces that chapters have recently been organized at Springfield, Mo., and Fresno, Calif. E. T. Bond is president of the Springfield Chapter and L. E. Smith is president of the Fresno Chapter.

The Detroit Engineering Society, at its meeting Sept. 19, listened to a talk on the new Detroit building code and the organization of the building department, given by John C. McCabe, commissioner of buildings for the City of Detroit.

The Rochester Engineering Society, Sept. 20, went in a body to inspect the gypsum mines of the Empire Gypsum Co., Garbutt, N. Y.

The New Jersey County Engineers' Association, in a recent meeting, decided to coöperate with the State Highway Department in the collection of traffic census figures in all sections of the state, in order that the tremendous increase in traffic may be met by more substantial construction of roads. Another question discussed was the influence exerted upon property owners in attempting to have governing bodies adopt one particular form of pavement, regardless of the advice of engineers.

The Pittsburgh and Lake Erie Railroad Section of the American Association of Engineers was organized Sept. 15, with the following officers: President, D. F. Harvey; vice-president, Samuel Baker; secretary, M. Z. Balph; treasurer, Benjamin Aires. The section will affiliate with the Pennsylvania R.R. section. The organization meeting was attended by 35 engineers, some of whom represented the Monongahela Railroad.

The Cleveland Chapter of the American Association of Engineers recently adopted a resolution favoring a canvass of political candidates to secure an expression of opinion on the desirability of appointing engineers to engineering positions in the public service.

The New York Chapter of the American Association of Engineers will have as principal speaker at the meeting Sept. 24 Maj. Gen. John F. O'Ryan, U. S. A., former commanding officer of the 27th Division. The subject chosen was "Compulsory Military Training in the Scheme of National Defense."

The Indianapolis Chapter of the American Association of Engineers is devoting some study to the question that has been carried before the Federal Trade Commission of making Pittsburgh a single basing point for steel. Steel consumers have protested against the practice of paying a set price for steel plus the freight rate from Pittsburgh, which may be considerably more than the actual rates from the point of shipment to the consumer. The question has been discussed by the Indianapolis Chapter, and a committee has been appointed to make recommendations upon which action will be based.

The Cleveland Engineering Society had as its speaker at the meeting Sept. 23, 1919, M. T. Harrington, consulting engineer. Mr. Harrington's subject was the relationship existing between the engineer and salesman. L. A. De Blois, engineer, the du Pont Co., Wilmington, Del., will be the speaker at the meeting Sept. 30. His subject will be "The Engineer's Place in Safety Work."

The Western Society of Engineers at its meeting Sept. 15 listened to two bridge papers presented in abstract by Dr. J. A. L. Waddell. The first was on economic span lengths for simple truss bridges on various types of foundations, while the second was on the comparative economies of cantilever and suspension bridges. Announcement was made of a campaign for new members and of arrangements for coöperation with the local members of the American Society of Civil Engineers.

PERSONAL NOTES

LIEUT.-COL. ARTHUR J. SLADE, U. S. A., having recently received his discharge from the service, has resumed his practice as a consulting engineer at 1790 Broadway, New York City. Colonel Slade's service in the United States Army involved the engineering work in connection with the design and production of motor transport vehicles for the air service, and in the training of operating and maintenance personnel. While in the American Expeditionary Forces he organized and directed the engineering division of the Motor Transport Corps, was a member of the International Armistice Commission, and while in the Army of Occupation made a collection of German military trucks of all types for the purpose of engineering research by the War Department. While in France he received the Distinguished Service Order from the British, and the Legion of Honor from the French Government. Before entering the service, Colonel Slade was engaged in mechanical, electrical, civil and automotive engineering, specializing in the design, manufacture, installation, operation and maintenance of commercial motor vehicles.

CARLOS LOBO, formerly borough engineer, Department of Water-Supply, Gas and Electricity, Borough of Brooklyn, New York City, has resigned to become affiliated with the Kelvin Engineering Company, Inc. He is to take charge of a new department of general engineering and contracting work that will operate in Latin America as well as carry on work in this country.

J. W. KAERTH, former county surveyor of Colusa County, California, has opened private offices in Colusa and is specializing in reclamation and irrigation work. Associated with Mr. Kaerth is GEORGE H. MECK, formerly connected with various reclamation projects in the Sacramento Valley.

ROY D. COLEMAN, county engineer for Atchison County, Kansas, for several years, has been appointed Government resident engineer for the Atchison district in the construction of hard-surface roads. ROBERT KERR has been appointed county engineer.

CAPT. G. L. MCLAIN, U. S. A., former city engineer of Hutchinson, Kans., has been appointed assistant engineer, Bureau of Public Roads, and has been assigned to the Omaha district, in charge of Kansas work. Captain McLain organized Co. A., 110th Engineers, and has just returned from 16 months' service in France.

E. V. R. PAYNE, senior assistant engineer of the New York State Engineers' Department, and former lieutenant colonel of engineers, U. S. A., has been decorated by the French Government for services in France in connection with construction work he carried on at Brest. He has been made a Chevalier of the Legion of Honor. Mr. Payne has been connected with the Engineer's Department of New York State since 1896.

PAUL HARTUNG, deputy county engineer of Jackson County, Missouri, has been appointed engineer of sewers, vice A. D. LUDLOW, who recently resigned the former office.

HAROLD F. GRAY, former district health officer, Chico, Calif., has been appointed State Sanitary Engineer of New Mexico, with headquarters at Santa Fé.

CAPT. E. S. CHASE of Eaglesmere, Penn., has been made engineer for the Williamsport Water Co. He was engineer at the Eaglesmere resort for thirty years. Captain Chase was the engineer selected to make the investigation of the water-supply for the new Rockview State Penitentiary near Bellefonte, Penn.

S. E. COLONY, Renovo, Penn., has been made borough engineer of Ridgway, Penn., being elected at a recent special meeting of the town council. He was formerly borough engineer for Renovo.

R. W. CREUZBAUR, after two years with the Emergency Fleet Corporation as consulting engineer, will resume private practice in his New York office Oct. 15. His work with the Government has been as consulting engineer in direct charge of the three well known plants at Hog Island, Bristol, Penn., and Newark, N. J. The cost of work included in these three projects aggregated approximately the sum of $90,000,000.

JOSEPH A. WHELAN, Trenton, N. J., has been appointed assistant superintendent of the Michigan State Highway Department, with headquarters at Ann Arbor. He was engaged in road-building in Trenton for some time.

CHARLES A. BROWNE, of Orlando, Fla., division engineer for the state road department, has been appointed State Highway Engineer of Florida, vice WILLIAM F. COCKE, resigned.

ALLEN P. RICHMOND, JR., graduate of Dartmouth College and the Thayer School of Civil Engineering, has been appointed assistant professor of civil engineering in the Thayer School.

LIEUT.-COL. F. W. SCHEIDENHELM, Engineers, U. S. A., has been discharged from the service and has returned to New York to resume his consulting practice, in association with DANIEL W. MEAD, specializing in hydroelectric work. Colonel Scheidenhelm went to France in October, 1917, and was engaged chiefly in water-supply work, having command of the 26th Engineers and acting as water-supply officer of the First Army. For his work in that capacity he was cited by General Pershing "for exceptionally meritorious and conspicuous service."

A. M. VANCE, late of the Kaw Paving Co., has accepted a position in the paving department of the Henry Exall Elrod Co., Dallas, Tex.

MAJ. WILBUR M. WILSON, U. S. A., who, since receiving his discharge from the service, has been engaged in general engineering work in Chicago, is again to become associate professor of structural engineering, University of Illinois, a position he held before he entered the service as a captain of engineers.

W. E. ARNETT has been elected director of streets and CLYDE MORRIS, director of the water department of Fairmont, W. Va., in a recent organization of the new city government.

R. W. THOROUGHGOOD has resigned as professor of civil engineering, University of Florida, Gainesville.

LINN BROWN, who is shortly to be released from military service, has been appointed city engineer of Jefferson City, Mo.

OBITUARY

RICHARD HELSON, Detroit, for 10 years president of the Carpenter Contractors' Association, and president of the Builders and Traders' Exchange for five years, died in Detroit recently at the age of 80 years. Mr. Helson started in the contracting business in 1862, being employed by his uncle, William Gibbings. Mr. Helson was associated in business for 20 years with W. G. Vinton, leaving his employ only when he entered the contracting business for himself.

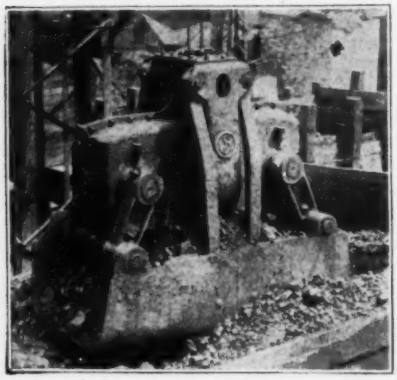
ROBERT WEDDELL, founder of the Weddell Bridge & Engine Works, of Trenton, Ont., which executed many contracts for the Dominion Department of Railways and Canals and the Department of Public Works, died at Trenton recently. Mr. Weddell was born in Edinburgh, Scotland, in 1850. He went to Canada in the early '80's, working for a time at Oshawa, shortly afterward moving to Trenton and establishing himself in business. Projects in which Mr. Weddell was professionally interested extended from Lake St. Louis in Quebec, to the Soo, including the Toronto harbor western entrance, the Trent canal, and other works.

THOMAS H. COLLINS, brick highway engineer of the Denny Renton Clay Co., Seattle, since 1912, died recently at his Seattle residence after an illness of two years. Mr. Collins went to Seattle from Cleveland, Ohio. While in the East he represented brick-manufacturing interests on various highway projects in Eastern and Southern states.

Clamshell Bucket Is Operated by Gears Completely Inclosed

A clamshell bucket operated by gears completely inclosed in a casing, instead of by open parts with which the material handled comes in contact, is shown in the accompanying illustration. By means of this arrangement, it is claimed, the many delays due to the necessity of removing and replacing worn parts are eliminated.

Ordinary clamshell buckets are so constructed that a large quantity of the materials handled comes in contact with the operating parts, the inevitable result being excessive wear. The bucket described is operated by gears which are incased in a securely bolted gear



BUCKET CLOSES BY GEARS

box, so constructed that the gears operate in what is practically an oil bath. They are thus constantly lubricated. The power for operation is transmitted by two wire ropes and can be handled by almost any type of two-drum hoist.

Having a minimum number of parts, with no extended chains or ropes reeved on small sheaves, the bucket is simple, compact and efficient. It is especially designed for handling coal, sand, gravel and cinders. For this work the buckets are so hung that they will dig very thin depths of material. On account of the small diameter of the closing pinion, the bucket requires a very small amount of rope either for opening or closing.

The bucket is manufactured by the Wellman-Seaver-Morgan Co., Cleveland, Ohio.

Will Burn Houses To Prove Fire Resistance of Metal Lath

During the week of Oct. 6-11, and coincident with Fire Prevention Week, (held under the auspices of the National Fire Protection Association, the United States Department of Commerce, the Board of Fire Underwriters and other national organizations) the Associated Metal Lath Manufacturers plan to give exhibitions of the fire-resistant qualities of metal-lath construction, by constructing composite houses of fire-resisting and non-fire-resisting construction and burning them, in as many places as possible.

The houses are designed according to a plan arranged by the Society for Fire Resistance Frame Construction, so that one-half is built with the usual wood-lath construction and the other half with fire-resisting frame construction using metal lath on the inside and metal lath with stucco on the outside. Copies of the design are to be distributed in various sections of the country, and it is planned to construct the houses and burn them on Fire Prevention Day, Oct. 9.

BUSINESS NOTES

THE STEWART MOTOR CORPORATION, Buffalo, N. Y., is about to enter its new plant, which will have a yearly production capacity of 10,000 motor trucks. The new factory covers approximately nine acres. The plant now occupied by the company will be operated in conjunction with the new factory.

THE SERVICE CONSTRUCTION CO., Cleveland Ohio, has been organized, and is preparing to enter the construction field for large buildings and commercial and industrial structures. Horatio Ford is president of the new company. Headquarters will be at 6110 Euclid Ave., Cleveland, Ohio.

THE BARBER-GREENE CO., Aurora, Ill., is making another extensive addition to its factory, this being the second one made during the year. The new area will be used in the manufacture of standardized material-handling machinery, belt conveyors and self-feeding bucket loaders.

THE PRATT & CADY CO., INC., Hartford, Conn., has appointed E. Coit Magens, formerly with the H. Belfield Co., as director of sales.

CHARLES L. PERRIN, until recently associated with PATRICK MCGOVERN under the firm name of P. MCGOVERN & Co., has retired. Mr. McGovern will continue the contracting business at the same offices, 50 E. 42nd St., New York City, and in Boston, Mass.

R. S. GILDEN, having been relieved from Government service, has again organized a contracting and construction company, being associated with S. Herzig. The new firm will be located at 188 Montague St., Brooklyn, N. Y. Mr. Herzig will continue his practice as consulting engineer.

THE ATLAS MINERAL PRODUCTS CO., Lincoln, N. J., has informed its clientele that, beginning Oct. 1, the main office of the company will be at Mertztown, Penn.

THE LANCASTER STRUCTURAL & FOUNDRY WORKS, Lancaster, Penn., has purchased the property of the Lancaster Machine & Structural Works. W. Edward Lindsay has been made engineer, and Edgar G. Hess, formerly connected with the Lancaster Foundry Co., is the works manager of the Lancaster Structural & Foundry Works.

THE CONSTRUCTION CO. has been organized as an auxiliary of the Minneapolis Steel & Machinery Co. to carry on the company's construction business, formerly handled by the Twin City Co. The Construction Co. will handle all steel erection, construction of buildings, bridges, water towers and tanks, barges, boats, elevators, etc. The Twin City Co. is to be used as a sales company only and will take care of the sale of all products of the Minneapolis Steel & Machinery Co. The officers of The Construction Co. are A. M. Burch, president, and Guy P. Johnson, secretary-treasurer.

THE DERRICK & HOIST CONSTRUCTION CO. is the firm name of a new organization formed by Harry Hyman, formerly designing engineer with the Edward F. Terry Mfg. Co. and J. Obstler. The offices are located at 150 Nassau St., New York City.

THE TWIN CITY CO., through its reorganization due to the establishment of the Construction Co., as noted elsewhere in these columns, announces the following new officers: President George L. Gillette; vice-president, N. B Nelson; secretary, E. A. Merrill; treasurer, Cal Sivright.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE AMERICAN MOTOR TRUCK CO., Newark, Ohio; folder, 9 x 12 in., four pages, illustrated; describes plant and product of the company.

THE NATIONAL TUBE CO., Frick Building, Pittsburgh, Penn.; Bulletin No. 7, 8½ x 11 in., 16 pages, illustrated; describes the process of manufacturing welded scale-free pipe, and gives information regarding friction velocities, etc.

THE BLAW-KNOX CO., Pittsburgh, Penn.; Catalog No. 18, 7½ x 10½ in., 40 pages, illustrated; describes Blaw system of building construction; also folder, 8½ x 11 in., four pages, illustrated; gives information regarding the acquisition of patents, personnel and equipment of the Uniform Company.

THE MILLIKEN BROTHERS MANUFACTURING COMPANY, INC., Woolworth Building, New York City; two catalogs, Nos. 10 and 11, 11 x 8½ in., 44 and 31 pages, respectively, both illustrated; No. 10 describes standard buildings of the company, with prices, tables of shipping weight and other information; No. 11 is a handbook on the erection of the buildings.

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